VOL. XIX. No. 5 MAY 1934

MECCANO MAGAZINE



"A CLOSE FINISH!"
(see page 369)

6D.

SPEED BOATS

REALISTIC DESIGNS, POWERFUL CLOCKWORK MOTORS

These are the latest speed boats! Entirely new designs based on well known types of craft. They are of pleasing appearance and robust wooden hull, and are durably finished in coloured enamel. Reliable clockwork motors give each model a nice turn of speed and a long run.



OOO SIZE. A nicely made boat with rear cockpit. Motor compartment covered by metal deck with dummy ventilators. Length, 10 ins. **1/-**



OO SIZE. Strong clockwork motor in watertight compartment with metal deck and dummy ventilators Rear cockpit with celluloid windscreen. Nicely lined on sides of hull with two contrasting colours. Length, 11 ins. **2/6**



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PRICES OF CLOCKWORK MODELS

No. 2. Length, 21 in. **10/6**

No. 3. Length, 24 in. **15/-**

No. 4. Length, 29 in. **21/-**

No. 5. Length, 33 in. **30/-**



These boats are hand constructed from selected seasoned mahogany. The powerful clockwork motor is enclosed in a watertight compartment with screw-on cap over winding shaft hole. Adjustable tiller, stop and start lever. Large cockpit with windscreen. Sizes 3E, 4E and 5E are fitted with a high-speed electric motor which operates from dry batteries. Each boat has a bow pennant and stern flag.

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With the Editor

From May Day to Labour Day

For many centuries May Day has been one of the principal rural holidays of the year, and there is a wealth of interesting custom associated with it, ranging from the ceremonial gathering of May blossom to dancing round the Maypole. In these days of great cities country life has lost much of its interest and importance, and such innocent amusements have largely come to an end. May Day is still celebrated in many districts, however, and new customs have arisen to take the place of those no longer observed. Most of my readers will have noticed the unusual gaiety of horses on May Day, for in many towns and cities these animals are groomed with special care, and decked out in finery of many colours. In addition, either on May Day itself, or on some more convenient day during the month, processions of horses are held.

The zeal for processions at this time of the year has led to the association of May Day with a political movement, and throughout the civilised world the first day of the month is now known as Labour Day. This is celebrated by processions leading to meetings in the open air that give opportunities for the expression of Labour and Socialistic views on world affairs in general, and thus in many respects the day has changed from a purely rural festival, expressive of the warmth and promise of the season, into one that is symbolic of modern industrial conditions.

In the past demonstrations of this kind have been more imposing abroad than in Great Britain. Recent political events will have curbed the activities of socialists in certain European countries, but in others, and particularly in Russia, to-day will be enthusiastically celebrated as the feast of Labour.



R. Robertson, an "M.M." reader, in an unusual scene. The lion cubs shown in such a life-like attitude in our photograph were killed on the Rhodesian farm of his father, whose article on "In the Zambezi Elephant Country" appeared in our March issue.

Our Dangerous Roads

The number of accidents, many of them fatal, that occur daily on our roads, has reached such appalling dimensions that the position is arousing great anxiety. The problem of preventing accidents, or of reducing their number, is a difficult one, for while it is easy to make regulations that promise to be effective, it is difficult to ensure that these will work out well in practice. The new Road Traffic Bill contains several interesting proposals that should be helpful, and two of these seem to be of special importance, one because it is a return to a former practice, and the other because of its novelty.

The new idea in the Road Traffic Bill is the imposition of driving tests for applicants for licenses. This is a step in the right direction, provided that the tests are carefully chosen to ensure that the applicant has learned to act automatically and therefore swiftly in emergencies. The speeds at which modern vehicles move make this a matter of the utmost importance, for disaster is likely to follow if the driver of a car involved in a threatened accident has to stop, even for a fraction of a second, to think about the actions necessary to avert the danger.

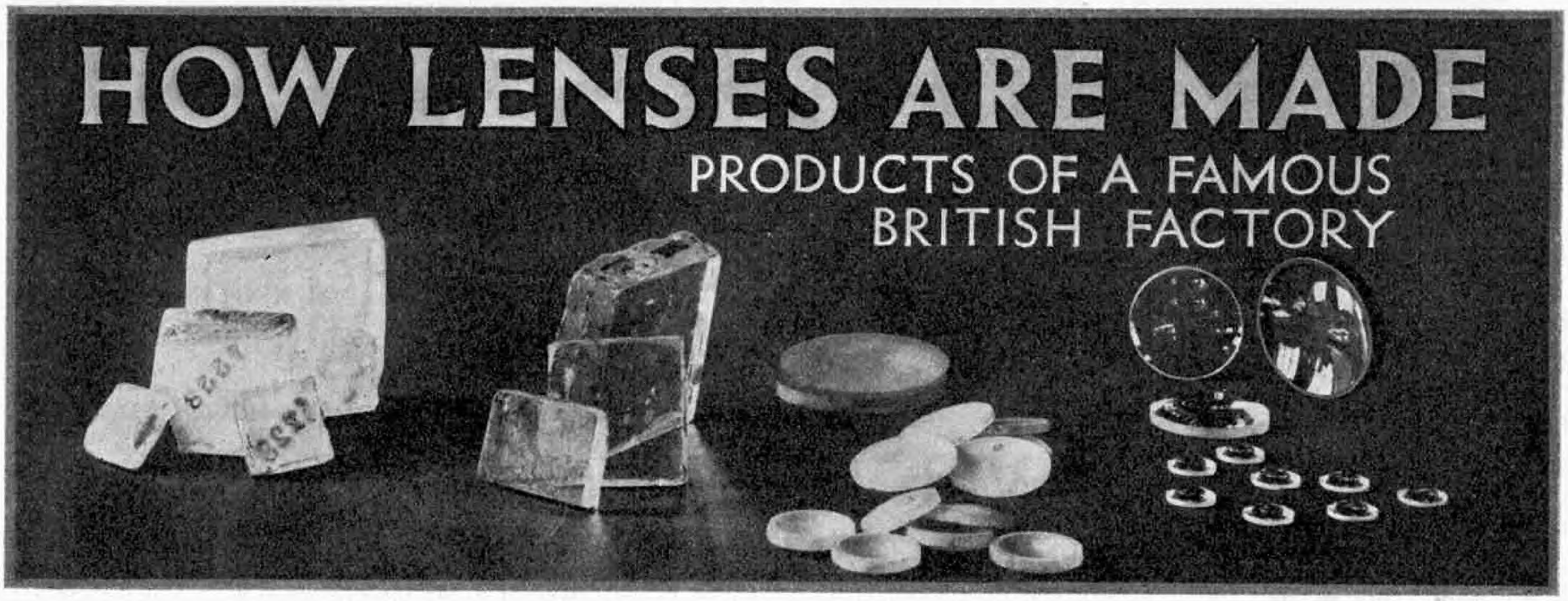
The second important feature of the new Bill is the proposal to impose speed restrictions in what are called "built-up areas," where traffic naturally is densest, and the number of possible victims of the dangerous driver greatest. Many motorists assert that there is no connection between speed and risk. I do not think this view will be shared by pedestrians who have found it necessary to jump out of the way of an oncoming motor car, for the faster a vehicle approaches the shorter is the time available in which to reach safety.

Speedways for Motorists

It is interesting to compare the position to-day with that existing a century ago when railways were new. The earliest steam vehicles were designed to run on the public roads, but conditions forced the pioneers of steam locomotion to make their own roads, and the magnificent British railway tracks of to-day are the result. These tracks are fenced in, and the traffic along them has always been carefully regulated by means of signalling systems, so that a very high degree of safety has been maintained.

I often wonder whether similar developments will become necessary in connection with motor traffic. To place on one and the same road slow-moving foot passengers, horse traffic that is only a little quicker, and a wide variety of steam and petrol vehicles of all sizes and of many different speeds, is simply to ask for trouble. To make matters worse, many of our roads are not really suitable for fast-moving traffic, even after the patching, widening and re-surfacing they have undergone in the attempt to transform them from country lanes and highways into speedways. It is not surprising, therefore, that the question of providing separate tracks for fast motor traffic is being seriously considered. At a recent meeting of railway shareholders it was suggested that tracks with hard smooth surfaces should be built alongside our main railway lines. These would be fenced in and devoted entirely to long-distance fast motor traffic, so that the drivers of the vehicles would be free to run at high speeds without endangering the lives of others.

A scheme of this kind would leave the ordinary roads free for local traffic and slow-moving vehicles, and would have the additional advantage, which many of my readers would appreciate, of reducing the nervous strain of the constant watchfulness necessary when walking or cycling along our roads. Thus it would restore to some extent the pleasure of leisurely exploring the countryside on foot and awheel.

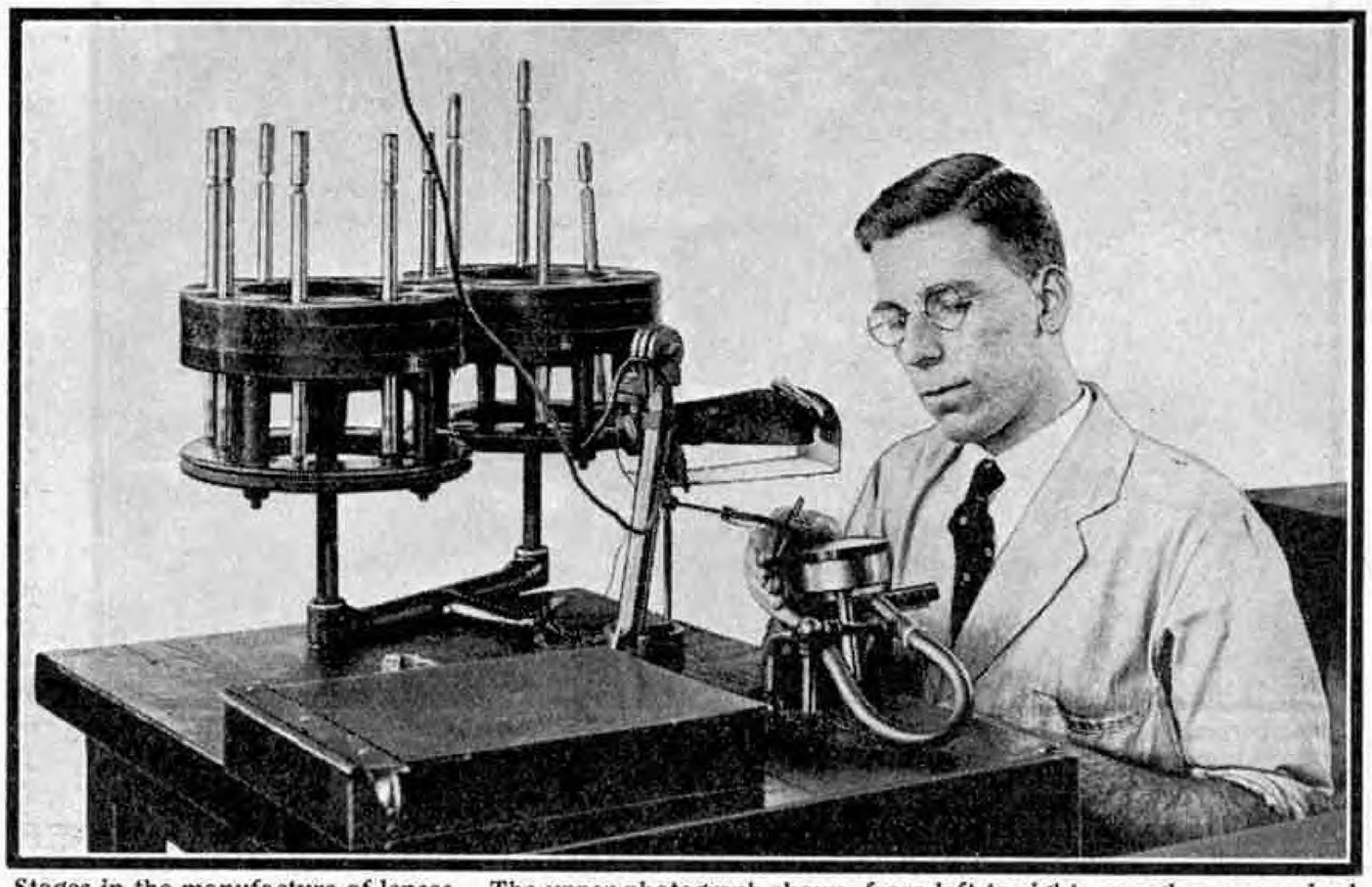


THE production of lenses dates back at least to the 13th century, when the first spectacles were made.

Lenses were used in a crude form of telescope devised 300 years later by an English mathematician named Leonard Digges, and as the science of astronomy developed it gave rise to a demand for lenses of greater accuracy and power. The growth of photography also helped in raising their production from the work of a few scientists to an important commercial industry. Simple lenses that gave very imperfect images were succeeded by others giving sharp images free from halos and distortion, in which two or more layers of different kinds of glass were cemented together. The achromatic lens introduced in 1732 by Chester Moore Hall is an example, and consisted of two glasses, an outer convex lens made of crown glass, and an inner concave lens made of flint glass.

The first modern anastigmat lens with uncemented glasses was devised by a man named Dennis Taylor, of York, whose Cooke lens, of 1893, was the pioneer of this type. The lens was designed for the astronomical telescopes produced by T. Cooke and Sons, but as they did not make ordinary photographic lenses they approached Taylor, Taylor and Hobson, a young Leicester firm already noted for their fine optical work, and asked them to make and sell the new lenses for photographic purposes.

The optical business of Taylor, Taylor and Hobson Ltd., was founded in 1886 by Thomas Smithies Taylor, one of the present directors of the firm, on an upper floor in a factory overlooking the old Midland Railway Station at Leicester. Across this building was painted a sign describing Mr. Taylor as "Optician and Scientific Instrument Maker." A few months later he was joined by his brother William, a mechanical and electrical engineer, who is now head of the firm, and subsequently by Herbert Hobson, when the present name of the firm was adopted. It is largely due to the inventive genius of William Taylor that the business has grown from a small beginning to its present large dimensions, machinery that he has designed for the production of lenses being used extensively.



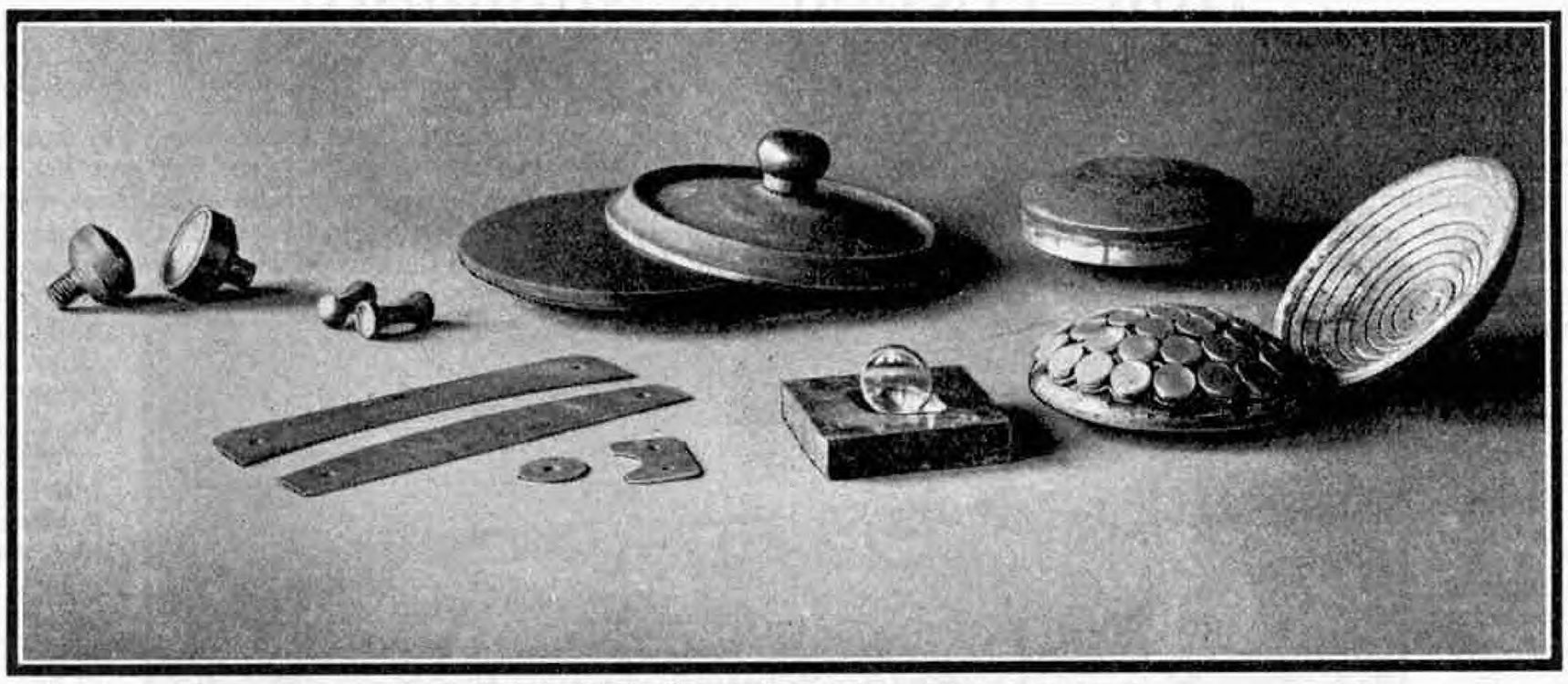
Stages in the manufacture of lenses. The upper photograph shows, from left to right, raw glass as received from the glassmakers ; glass polished for examination ; lenses roughed into shape, and a group of polished lenses. In the lower photograph a workman is centring lenses prior to edging. The illustrations to this article are reproduced by courtesy of Taylor, Taylor and Hobson Ltd., Leicester.

Before the Leicester works was established, lens making had been practised only on a relatively small scale, and the product varied in quality with the individual skill of the workmen. Accuracy is of vital importance in the manufacture of lenses, and among the first things to which William Taylor gave attention were the screw threads used for uniting the parts of the lens mountings, as on these threads depends the accurate positioning of the several glasses composing the lens. At that time there did not exist any adequate means for forming and measuring screw threads with the necessary accuracy, and for this purpose he invented the needles and prisms that are now used everywhere by engineers for the trigonometrical measurement of screw threads. These valuable devices also enabled this country during the War to produce screwed parts of shell, fuse and aircraft in thousands of independent factories with the certainty that they would screw together properly when assembled. Chasing lathes, chasers and limit gauges have also been invented at the Leicester works, and these ensure the accuracy of all screw threads within 1/1000th inch.

In the early days of the business it was found unsatisfactory to engrave lens mounts by hand, and this led Taylor to invent the Taylor-Hobson engraving machine. The value of this invention was quickly recognised, and

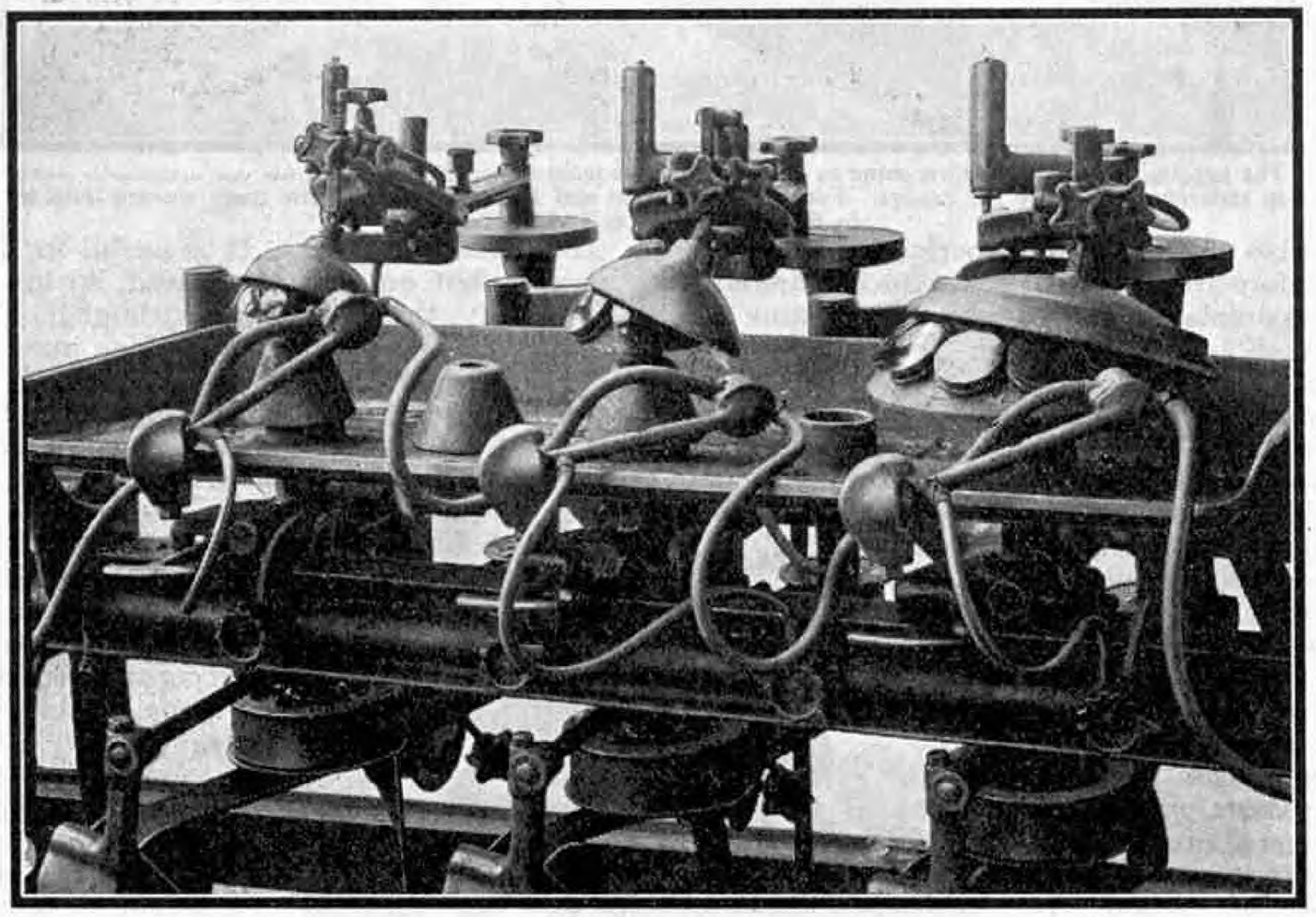
to-day these machines are manufactured by the firm and are used in all parts of the world, not only for the engraving of lens mountings, but also of instruments of all kinds; name plates, metal moulds for soap, rubber and biscuits; and for many other purposes that were never imagined by the inventor when he set to work simply to improve on the hand engraving of lenses.

William Taylor was an ardent golfer, and he invented and patented the "Dimple" marking of golf balls. The first moulds for balls bearing his marking were engraved on the engraving machine just mentioned. The success of this new venture led to the production at the Leicester works of accurate steel moulds for golf balls, tennis balls, and other articles known in the rubber trade.



An interesting collection of tools used in polishing the lenses.

The fame of the Leicester firm as lens makers grew steadily with the fame of the Cooke lens, mentioned earlier, and within a couple of years there was begun the erection of the present lens factory, which is the best equipped factory of its kind in the country. The manufacturing of a high grade lens is one of the most delicate of all mechanical operations. The curvature of the surfaces must be mathematically perfect, and they must have an extremely high polish. In the Leicester factory all manner of machines are employed in making the lenses. They include wonderful devices that grind the lenses to the correct shape, and machines that polish them with surprising speed and gentleness of operation. The lenses produced are interchangeable, all components being made within prescribed fine limits of error. Independent inspection at every stage of manufacture ensures that all lenses attain these high standards, while the methods of grinding and polishing also assist in maintaining uniform excellence.



A near view of one of the polishing machines, showing the automatic feeds which convey the fine polishing material known as "rouge."

The finished lenses are conveyed to testing rooms on an upper floor of the factory, where experts in lens research use all kinds of interesting instruments designed for testing lenses. In one of these final tests two rooms act the part of a huge camera and the lenses are mounted in the separating wall. Adjoining these rooms is a "dark" room where the pictures taken with this strange camera —pictures of engraved designs—are developed and printed for examination by the research specialists.

The labours of the research staff have resulted in the invention and production at the factory of lenses known everywhere to-day. Among them is the Taylor-Hobson Cooke Aviar lens, designed during the War to meet the demand of the British Government for a lens having speed and definition sufficient for aerial photography. This lens was the first to fulfil these exacting conditions, and it was adopted in 1916 by the Royal Flying Corps as the best obtainable.

The firm was also a pioneer in the production of large aperture lenses capable of transmitting the large volume of light necessary to reproduce images of the rapidly moving subjects in the film studios. Taylor-Hobson Cooke lenses of this class are used to the exclusion of most other makes in the best film studios in this country and in Hollywood. In the same way Taylor-Hobson projection lenses of large aperture have secured something like a monopoly among the "super-cinemas" throughout Britain and some of the Colonies for projecting the pictures on the screen. *"M.M."* readers who frequently visit the cinemas can safely assume that most of the films they see are produced and projected by means of lenses made at this factory.

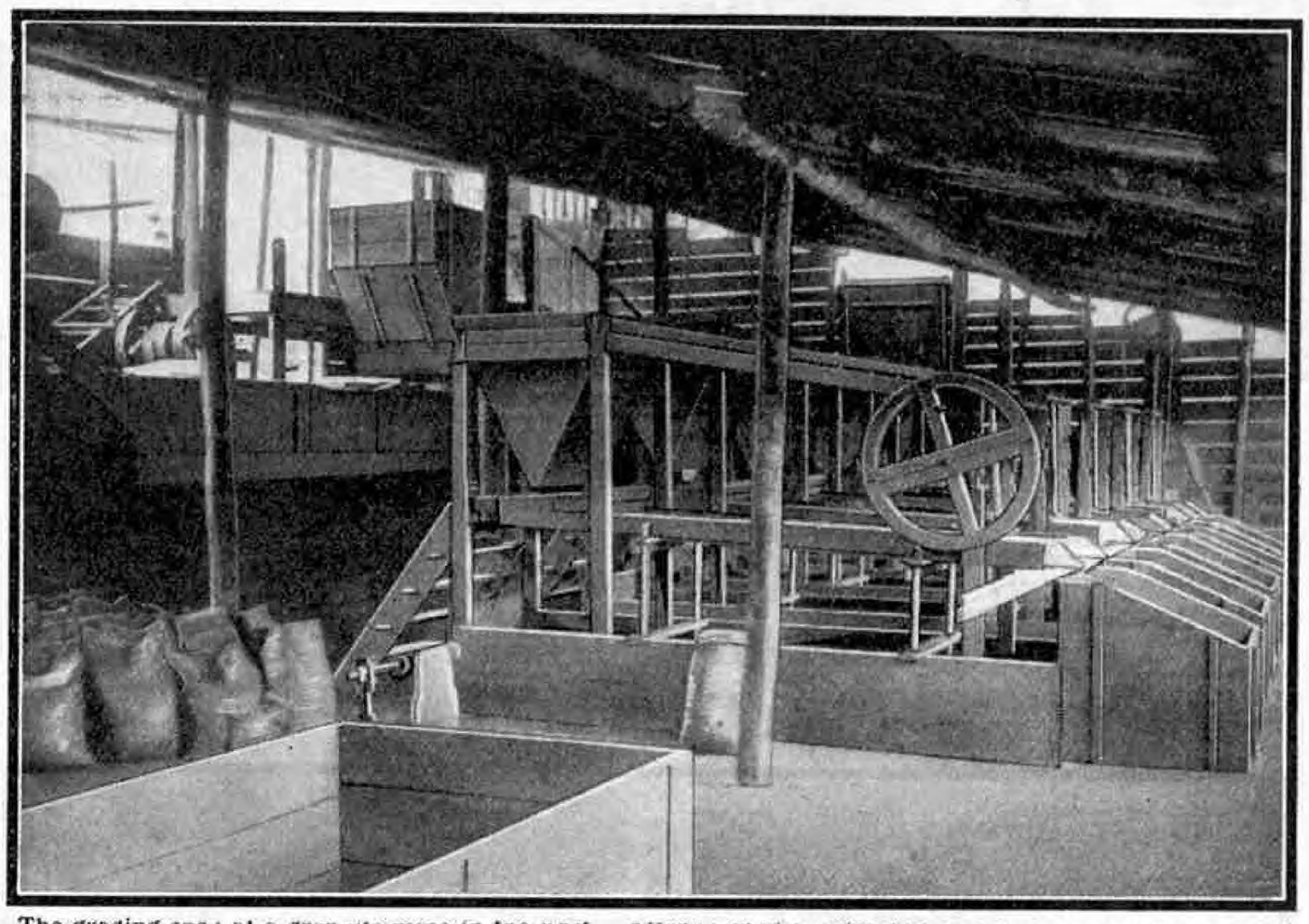
Another interesting branch of the firm's activities is the manufacture of the costly lenses used in some of the world's leading Observatories, such as the Royal Observatory at Capetown, the Harvard Observatory, Cambridge, Massachusetts, and the Mount Wilson Solar Observatory. These astronomical lenses are in constant use for photographing the stars, and it is the high degree of precision necessary in these costly products that enables the firm to design and make their own machinery capable of producing inexpensive lenses in vast quantities.

Lubricating Oils and Graphite Grease

How Friction is Minimised

ONE of the most important problems that designers of machinery have to solve is that of eliminating as far as possible the friction between rubbing surfaces such as shafts and bearings. Unless special means are adopted to reduce this friction to a minimum, moving parts rapidly become worn, and loss of power results. In a large and complicated machine having many moving parts, lack of proper lubrication may lead to the bearings and shafts becoming so overheated that they "seize," or become literally solid.

Lubrication by means of oil or grease has been practised from very early times, but it is only during recent years that the subject has been studied seriously. Nowadays chemists divide oils into two main groups, mineral and fatty. The various grades of mineral oils are obtained from crude petroleum or rock oil, and the fatty oils are derived from living organisms, either animal or vegetable. Mineral oils have been known for barely a century, and before their discovery, lubrication was carried out entirely by vegetable or animal oils. Unfortunately vegetable oils, which are superior in "oiliness" to the mineral oils and therefore are better friction reducers, are also very rich in volatile compounds, which lessens their value as lubricants for use where much heat is generated. For this reason, and also because they are cheaper, mineral oils now play a very important part in the lubrication of machinery.



The grading shed at a graphite mine in the East. After leaving the grading machine the mineral is stored in separate bins ready for export. For this illustration and those on the opposite page we are indebted to Graphite Products Ltd., London.

Animal oils and fats suitable for lubrication include sperm and common whale oil, neatsfoot oil, lard and tallow. Among vegetable oils, olive, cotton seed and rape seed are extensively employed, the last two usually being mixed with higher class and more expensive oils. Various fish oils also are used.

Not all lubricants are oils, however. Graphite or plumbago, which is one of the many lubricants used by modern engineers, is a solid black, lustrous mineral which, in combination with suitable greases, provides an excellent lubricant for certain kinds of machinery. Graphite is distributed widely throughout the world, and in its purest form it consists almost entirely of carbon. It varies considerably in quality, however, and the best is found in Ceylon. A small quantity is obtained in Scotland. It is now possible to produce graphite in the electric furnace, but the synthetic article is inferior in quality to the product of Nature's furnaces.

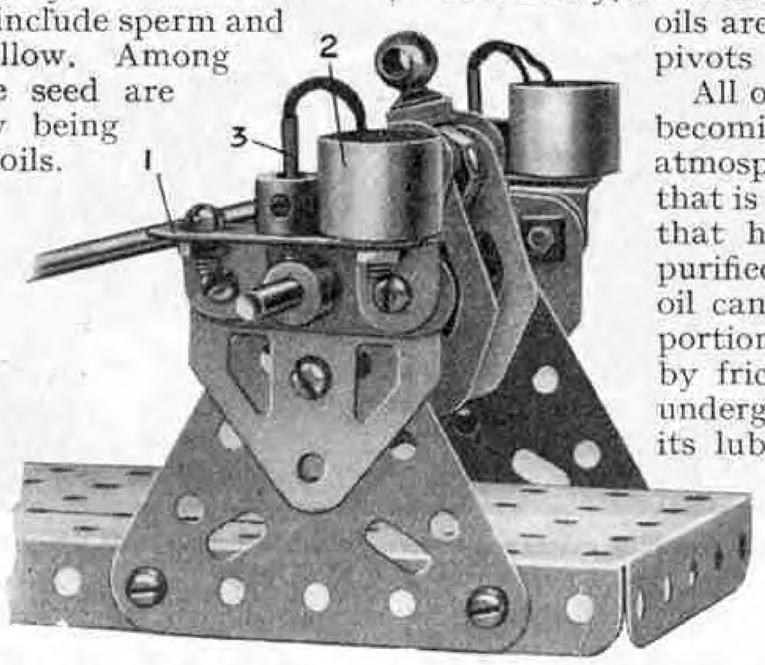


Fig. 1. A Meccano siphon wick lubricator suitable for lubricating models. Its construction is described in the accompanying article.

In Ceylon graphite is found in two well-defined forms, known as the crystalline and the flake. It is often obtained from open workings or shafts, the work being done mostly by natives, who carry the mineral in big baskets slung on their shoulders. The shafts are ascended and descended by means of peculiar bamboo ladders of native construction. In many cases the ore is simply washed out of the hillside by directing powerful streams of water against the face of the cliffs. The newly-mined graphite is passed through washing and various other cleansing processes to remove impurities. These operations are all carried on by native hand labour, and although the methods employed appear to be extremely crude, the resulting product is of high quality.

As a lubricant, graphite acts in a different manner from oil. Oil simply supplies a film of fluid between the rubbing surfaces, whereas the action of graphite is to fill all minute crevices and depressions in the metals of bearings and shafts, thus giving them such an even and smooth surface that friction is reduced to a minimum. Graphite lubricant, as used by engineers, may be in the dry form or made up into a thick grease. The grease is applied under pressure to the bearings of heavy shafts by means of "grease guns" or screw grease cups. This form of lubrication is largely employed in connection with hydraulic machinery.

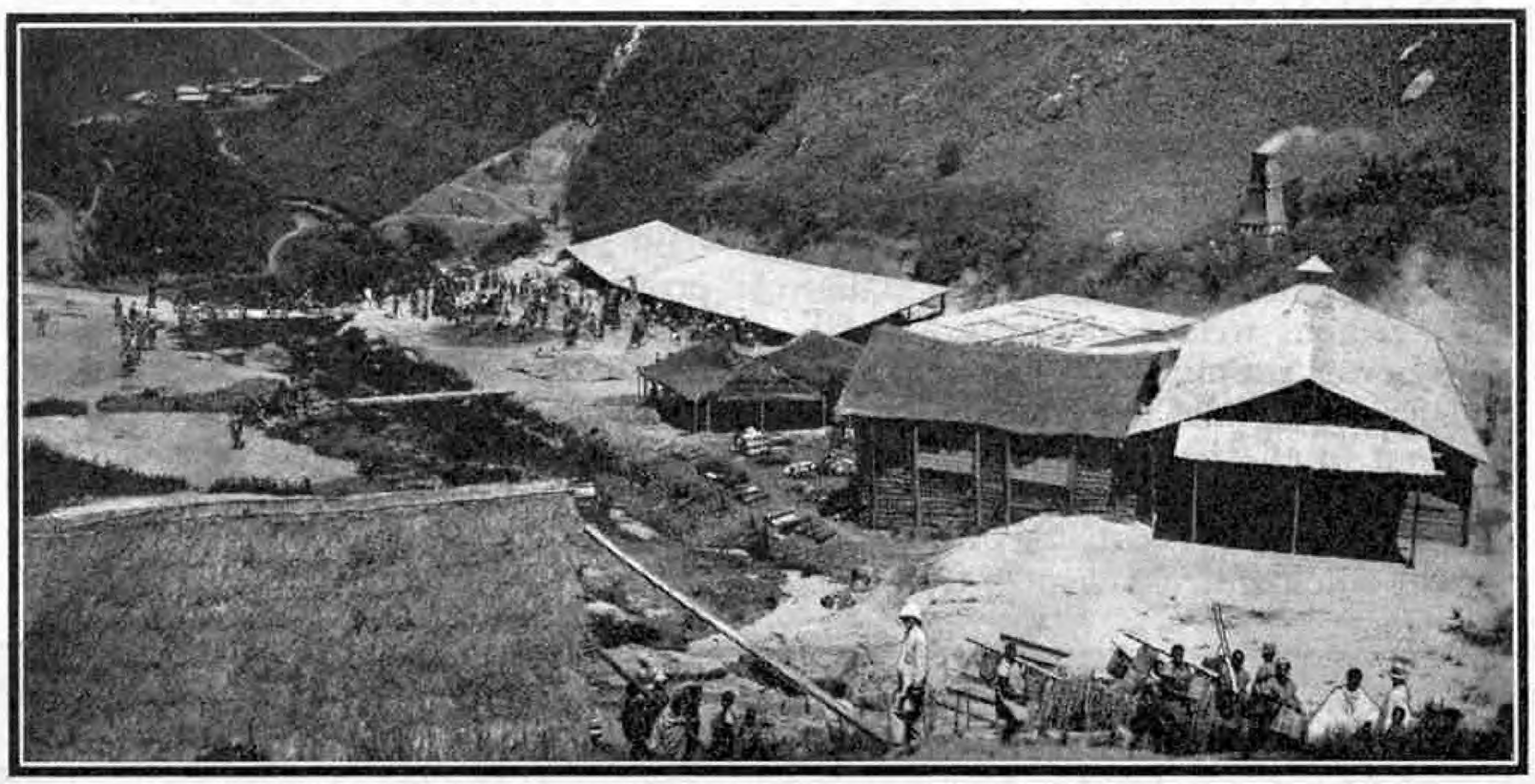
For railway lubrication different companies use different types and qualities of oil. For axles, valve motion, etc., rape oil is largely used, either alone or mixed with a small amount of mineral oil. Tallow was formerly used for a great variety of purposes, but it has fallen out of favour to a considerable extent. It is useful for axle-boxes that are running warm, but on the other hand, so long as the boxes are running normally, they are better without it. In sight feed lubricators for cylinders and slide valves a thick mineral oil is now generally used. Petroleums of various degrees of "body" are much used for general machinery, and refined sperm, hazelnut, porpoise jaw and neatsfoot oils are used for small and delicate work, such as the pivots of sewing machines, watches and clocks.

All oils gradually become worn out as lubricants by becoming filled with dirt, partly from the dust in the atmosphere and partly from the fine iron and brass dust that is continually rubbed off the bearing surfaces. Oil that has become defective in this manner can be purified to a certain extent by special processes, but no oil can be made to last indefinitely. A considerable portion of it is actually evaporated by the heat caused by friction, and the unevaporated portion seems to undergo chemical changes that are injurious to its lubricating properties.

Different kinds of machines necessitate different systems of lubrication, and among those now in general use are the "forced feed" and "splash" systems. In a forced feed system oil is pumped under pressure to all the necessary points of the mechanism. In the splash system a well is usually provided in the lower part of the crankcase in which the lubricating oil collects. Below each crank is an oil trough. A small dipper on the connecting rod end enters this trough when the crank is at its lowest point, and lubricates the pistons by splashing. In petrol engines a combination of forced feed lubrication in which the oil is pumped to the bearings, with the splash system, is usually adopted.

Efficient lubrication is of the highest importance in aircraft engines, which have to run smoothly and perfectly for long periods with little attention. For such engines there are two main systems of lubrication, the dry and the wet sump systems. In the dry sump system the main oil supply is stored in a separate oil tank that is

distinct from the engine unit. From here the oil is led to the engine through pipes in conjunction with which is a series of pumps. The types of pump employed differ, but they are at least two in number. One, known as the delivery pump, is fed with oil from the main tank, usually by gravity, and this pump forces the oil through the pipes to the bearings. The second pump is known as the scavenge pump, and usually has an increased capacity of 25 per cent. over the delivery pump. The scavenge pump withdraws the spent oil that has been flung out from the various moving parts it has lubricated, and has settled in the bottom of the crankcase, and returns it to the main oil tank, where it is cooled and made ready for a further circulation through the engine bearings. The greater capacity of the scavenge pump ensures that the delivery pump shall not over-run the return, and thus risk the possibility of the oil tank running dry.



A general view of an open graphite mine, in which the ore is washed out of the hillside.

The wet sump principle does not require an outside oil container or pipelines, and only one pump is necessary. The bottom half of the crankcase of a vertical or V engine has usually a large capacity and acts only as a bottom cover to the crankcase. This portion of the crankcase is therefore very suitable for containing the two or three gallons of lubricating oil that are necessary as an oil supply for the engine. The oil pump is usually submerged in a well at the base of the crankcase, and so a constant feed to it is ensured. The oil is then circulated either by pipelines or by channels cut or cast in the main crankcase casting to the main bearings. A continual supply of oil under high pressure is thus supplied to these vital moving parts, and the oil flung off from the big ends by means of centrifugal force also lubricates the cylinder walls and pistons and other moving parts. The oil then falls to the bottom of the crankcase where it mixes with the main supply and cools, so that it can be again circulated through the engine.

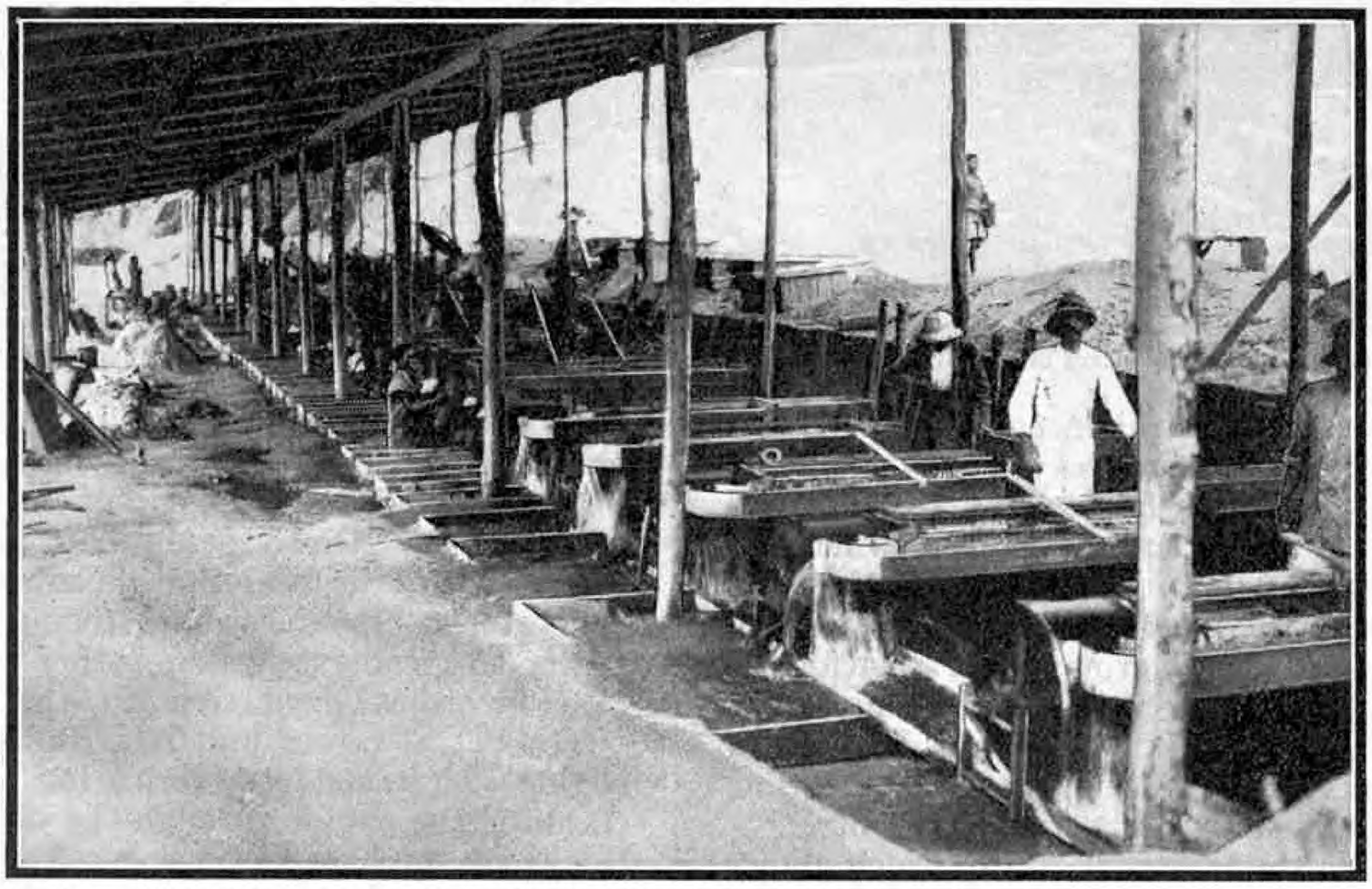
For automatic lubrication of mechanisms such as machine tools, presses, steam engines, agricultural and similar machinery, what are known as mechanical lubricators are used. Generally these are separate and self-contained units attached to and worked direct from the machine.

Lubrication is just as important in model machinery as in real engineering practice if wear and tear are to be reduced to a minimum and the model made to operate with the least possible expenditure of power. By means of appropriate oils and grease the friction of bearings can be greatly reduced, and in rapidly moving mechanisms any heat generated is rapidly dissipated.

For lubricating Meccano models of all kinds a special Meccano Oil is supplied, which is of exactly the correct consistency for the work it has to do. This oil will ensure the best possible running of any model to which it is applied. Thick, heavy oils should never be used for Meccano models, because they will clog the bearings and make the running worse instead of better. On the other hand, very thin oils are wasteful, because they are thrown out of the bearings before they have done their job properly. The special Meccano Oil is also ideal for lubricating Hornby locomotives and rolling stock.

In addition to the Meccano Oil, a special brand of Meccano Graphite Grease is available in tubes. This is a specially suitable lubricant for the springs of the Hornby Speed Boats and Racing Boats, and of Hornby clockwork locomotives. A small quantity of the Grease should be applied with a brush to the spring when this is almost, but not quite, unwound. Graphite Grease is also suitable for filling the axle boxes that are fitted to certain Hornby vehicles.

One of the commonest mistakes to make in regard to lubrication is that of applying too much oil. In addition to being wasteful, such a practice invariably results in oil reaching places where it may be actually harmful. For instance, if too much oil is applied to a Hornby locomotive, or to the axles of wagons or coaches, some of it is certain to find its way on to the rails and thus cause the locomotives to slip badly. The only remedy then is to clean the track thoroughly with a rag moistened with petrol. Two types of Meccano Oil Cans are obtainable, by means of which the most awkwardly placed bearings and shafts can be reached, and the oil applied, drop by drop, exactly where it is required.



In the washing shed shown here the graphite is separated from impurities. Afterwards it is dried in a kiln and graded into various qualities.

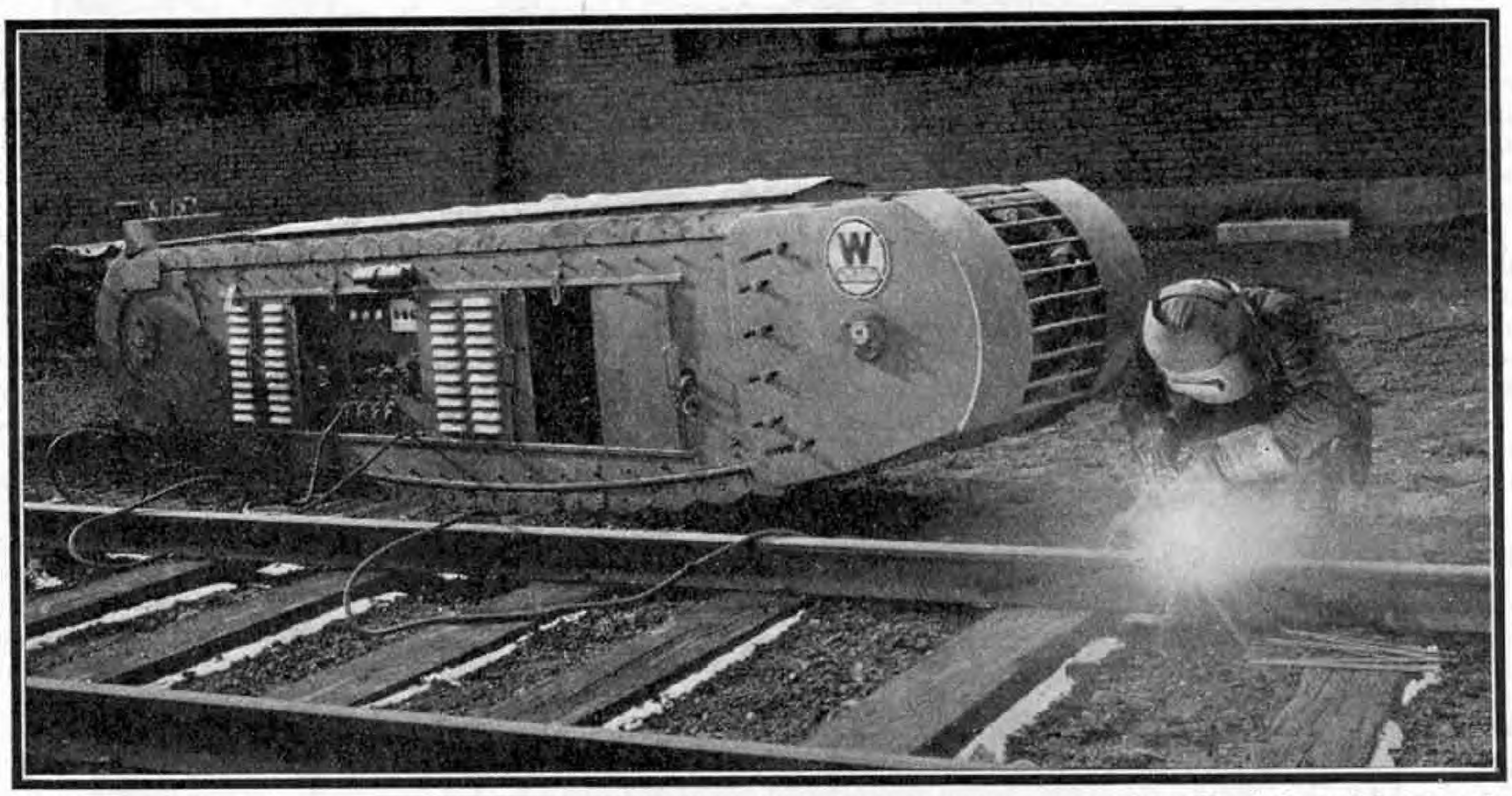
In rapidly moving mechanisms it is preferable to ensure a constant supply of lubricant to the working parts, and for Meccano models the simplest method of doing this is by means of the Meccano Grease Cups. To use these it is necessary to employ the boss of a crank or a wheel as the bearing, the Cup being screwed into the boss in place of the set screws. The Cup is filled with the Meccano Graphite Grease, and thus a supply of lubricant is provided that ensures that the bearings do not run dry. When oil is used, however, it is necessary to employ a different plan. A simple continuous oil supply system is shown in Fig. 1. It is based on what is known as the "siphon wick" method, in which the oil flows to the bearings along wicks. The illustration shows lubricators of this kind applied to a two-bearing crankshaft.

The crankshaft is journalled in Double Arm Cranks bolted to Flat Trunnions that are bolted in turn to 2½" Triangular Plates. A second Double Arm Crank 1 is secured at right angles by means of ½" × ½" Angle Brackets to each of the first-mentioned Cranks. A Chimney Adaptor 2, attached to one end of the Double Arm Crank 1, forms a neat oil cup. A length of worsted is threaded through a length of Spring Cord 3, its upper end being dipped into the oil cup and its lower end inserted in the set-screw hole of the Double Arm Crank that forms the bearing. The Spring Cord provides a convenient means of leading the oil-conveying worsted wherever it is needed.

A New Welder for Railway Maintenance

Remarkable American Tractor Machine

AS a result of extensive tests and research, the Lehigh Valley Railroad, U.S.A., purchased some time ago six unique tractor welders from the Westinghouse Electric and Manufacturing Company, for track maintenance work. This ingenious welder, developed to fill the need for a mobile power supply unit that does not require frequent transferring to and from the track for movement from one point to another, eliminates the use of long and expensive cable leads, and does not interfere with traffic or signal operations. It is capable of working along the shoulder of the track entirely clear of trains, it can ascend slopes up to about 35 degrees, and it is stable in operation on side slopes of 45 degrees.



Building up rail ends by means of the Westinghouse tractor welder. Photograph by courtesy of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, U.S.A.

As a result of the mobility of the machine, power losses are cut to a minimum by the use of relatively short cables. The cables furnished provide for welding 12 joints between moves. While this necessitates frequent movement of the tractor, the moves are made quickly by one man, and do not interfere in any respect with the permanent way. The tractor operator, when not moving the tractor, is able to do all the slotting and grinding operations of the newly-welded joints. Pivot turns are possible on any kind of ground, but a platform is usually carried with the tractor for use in crossing tracks and for convenience in making pivot turns. The use of the platform protects the rails, and at the same time prevents the tractor from closing signal circuits.

The overall width of the tractor is 30 in., which allows the unit to travel along the shoulder or between the rails. The height likewise is kept to a minimum to permit traffic clearance with the welder on the shoulder of the track. It measures 36 in. from the ground to the top of the upper tread.

On account of the tractor's ability to ascend slopes of 35 degrees, it can climb readily on to a flat car with the use of an approach ramp consisting of two timbers placed at the side or the end of the car. Where conditions require the use of a crane, removable hooks are provided for ease in hoisting the welder on to the car.

The tractor structure consists of a supporting steel framework, the sides of which are enclosed with heavy steel plate having suitable openings for ready access to generator controls, petrol engine, etc. A bulkhead is built into the rear of the tractor frame on which the two propulsion motors are mounted. This bulkhead, motors, worm gearing and tread sprockets are removable as one unit, thus facilitating maintenance. The front is provided with enclosures and cross rods, forming a guard against damage to engine radiator, treads and idling sprockets. These sprockets are adjustable to take up slack in the treads resulting from the gradual wear of parts. Two driving sprockets, mechanically separate, are geared direct to the propulsion motors, and placed one on each side at the rear of the tractor.

A Westinghouse FlexArc welding generator provides welding current for one operator, and on account of its special features is capable of handling both bare electrodes at the lower voltages, and coated electrodes at higher voltages. One bracket type ball bearing is placed at each end of the unit frame generator construction. On the same shaft, and built into the unit frame with the welding generator, is an auxiliary generator, compound wound, for supplying direct current power to grinders, slotters, other tools, and lights. It also furnishes excitation to the welding generator.

The petrol power unit is a Buda six-cylinder 65 h.p. engine with forced feed lubrication. Provision is made for cranking the engine through the side of the tractor, and this is accomplished by using a 3 : 1 gear ratio arranged to engage and disengage with the engine crankshaft.

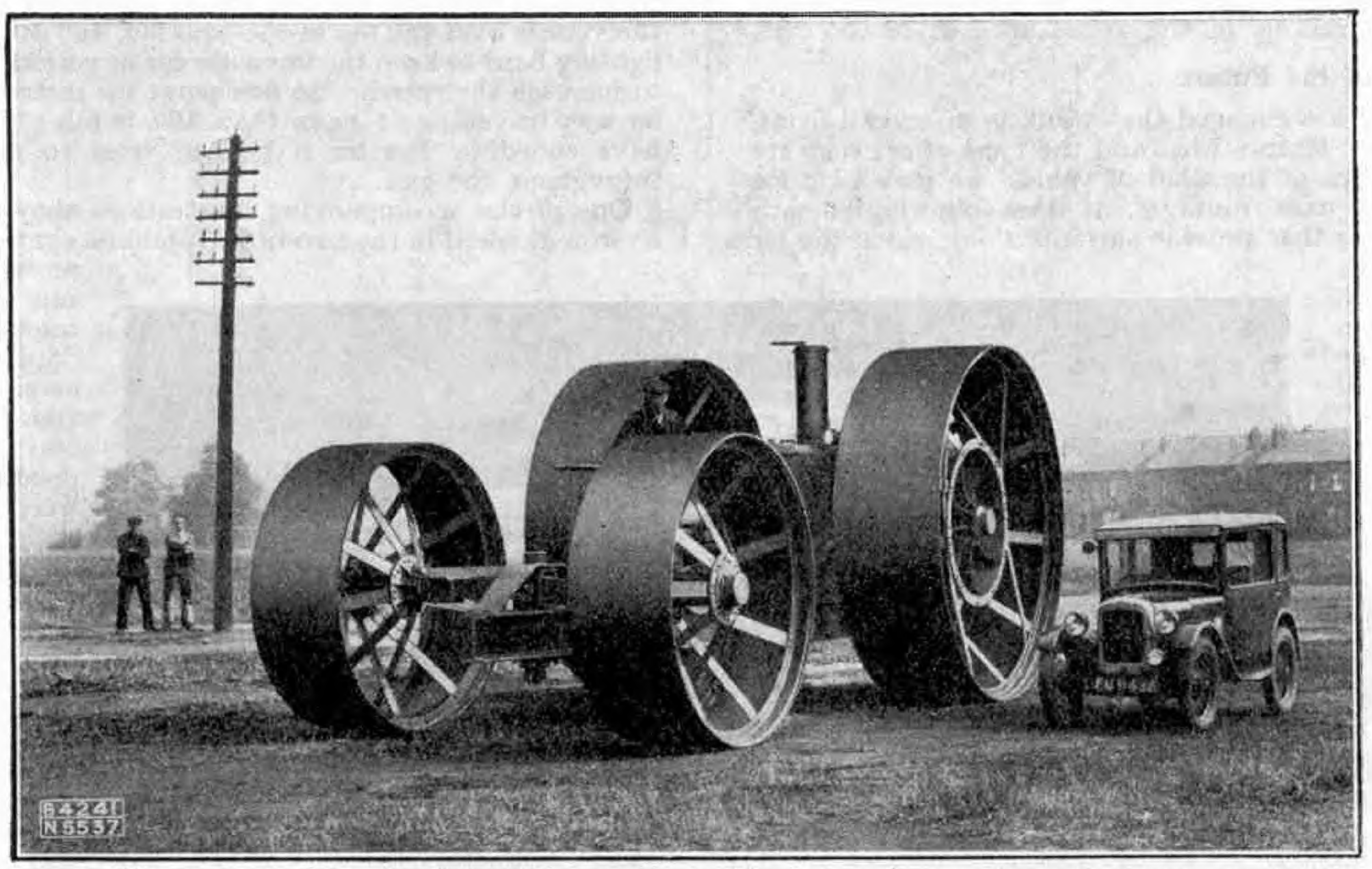
The two propulsion motors take their power from the variable voltage, constant current, welding generator. The speed is regulated by varying the field excitation of the welding generator by means of the rheostat on the welding control panel. Hand-operated drum switches, one for each motor, provide for forward and reverse movements, as well as for starting and stopping the tractor. Turning of the tractor is accomplished by stopping one motor and operating the other, or else by "inching" one motor while the other is running at full speed. Forward motion in a straight line requires the operation of both motors at their common speed.

World's Largest Roller

A Novel Machine for Making Embankments

THE illustration on this page shows a remarkable type of steam roller built by Marshall, Sons and Co. Ltd., Gainsborough, for the Durham County Water Board. This roller is the largest in the world, and has been designed specially for use in consolidating embankments and reservoirs, a task involving peculiar difficulties that make an ordinary road roller quite unsuitable. It is used for forming solid embankments from earth and soft clay, and in the course of its work it has to ascend very steep gradients, sometimes having to traverse slopes as great as 1 in 3.

The roller travels at a speed of between two and four miles per hour in either direction, and is driven by a 100 b.h.p. engine supplied with steam at a pressure of 275 lb. per sq. in. Its overall length is 23 ft. 6 in., and its width 12 ft. 6 in. The rear rollers are 10 ft. in diameter and have a width of 3 ft., and the front rolls are 7 ft. in diameter with a width of 2 ft. 6 in. In complete working order the roller weighs 16 tons.



The world's largest Steam Roller, described on this page. Its great size is shown by comparison with the motor car standing alongside. Photograph by courtesy of Marshall, Sons and Co. Ltd., Gainsborough.

It frequently happens that the roller has to work on a slope with one of the rear wheels from 3 ft. to 4 ft. above the other, and this is why the great width over the rolls is necessary. It will be seen that the front rolls are separated, and placed one at each side of the machine. This form of construction serves a dual purpose. It prevents soft material from being jammed between the rolls, which is often the case with an ordinary roller where the rolls are close together, and also it enables the roller to work astride the railway tracks that convey the refuse and other materials to the various banks.

The ideal rolling machine for embankment work would be one with a large unbalanced weight to give the maximum vibration as the roller moved along, but unfortunately the weight necessary would have to be of such proportions that a very heavy roller would be required to stand the strain, and difficulty would be experienced in maintaining a roller under such conditions. In the Marshall roller the necessary vibration is obtained without the use of unbalanced weights, by fitting large cross strakes to the front and rear rolls. The strakes project 5 in. to 6 in. and provide a useful bumping effect when the roller is on hard material.

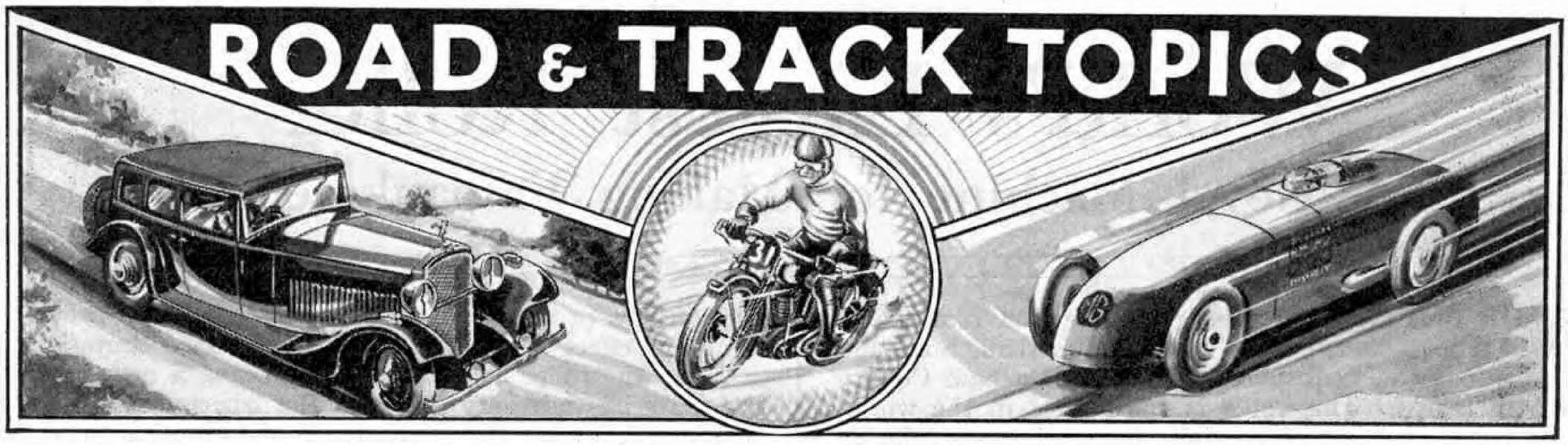
When the roller commences to work on a new bank the materials are very soft and the wheels are partly submerged. With the continuance of rolling, however, the material gradually becomes more solid and offers more support to the machine. It is then that the effect of the strakes fitted to the rolls becomes useful. Owing to the great diameter of the rolls, only the strakes come into contact with the ground when the machine is working on hard material, and the result is that when the bank has been consolidated sufficiently to support the roller the machine bumps from one strake to another and so performs the final process of consolidation.

The strakes referred to are not shown in the illustration as they had been removed to enable the roller to travel on the highway. Actually the strakes consist of lengths of " T " girders bolted across the full width of the front and rear rolls at regular intervals around the circumference.

Sometimes the materials on which the machine has to work are extremely soft, and the rolls become so deeply embedded that an ordinary road roller would be incapable of moving. Such conditions are no hardship to the giant Marshall roller, however, for it is so powerful and efficient that it will continue working even when all four wheels are embedded to the extent of 12 in. or more. The monster derives its power from a " Sentinel " two-cylinder high-pressure steam engine and boiler unit, which has a constant torque at all speeds and ample reserve of power.

When the machine was first put to work it was driven up a gradient of 1 ft. in $2\frac{1}{2}$ ft. leading from the workshops to an embankment, and even under these very trying conditions the engine was no more heavily taxed than it frequently is when working in soft materials on the level.

Only 100 lb. to 150 lb. steam pressure is used for level rolling in soft material, but the full pressure of 275 lb. is needed on 1 in 3 slopes.



NO doubt many of my readers at times try to imagine what the car of the future will be like, and visualise the small but powerful engines which, in conjunction with such developments as fluid flywheels and infinitely variable gear-boxes, will give high cruising speeds with perfect safety and without fatigue on the part of the driver. Streamlining then will become an important problem, and efforts to reduce wind resistance will bring about far-reaching alterations in the appearance of motor cars.

The Streamlined Car of the Future

Streamlining already has engaged the attention of several firms. One of these is Chrysler Motors Ltd., and the type of car they are introducing gives an idea of the kind of vehicle we may look for in future. It has no square frontages, its lines following smooth curves from front to rear that provide surfaces along which the air can flow freely past, instead of forming eddies and offering opposition to the progress of the car. Our illustrations of a car of the "Airflow" type, as the new range is called, show how this result has been achieved, and it is said that air resistance is reduced by 40 per cent. in comparison with that of a car of conventional type.

The streamlining of the Chrysler Airflow car is not its only novel feature, for an entirely new system of building has been introduced. The car is in effect a massive girder, for it consists of a steel framework that completely encloses the engine and transmission as well as the space allotted to the driver and passengers. It is claimed that the body of the new car is 40 times more rigid than that of a car of ordinary type, and that its design affords a far larger measure of protection in the event of a collision or other accident than is possible with other types of construction.

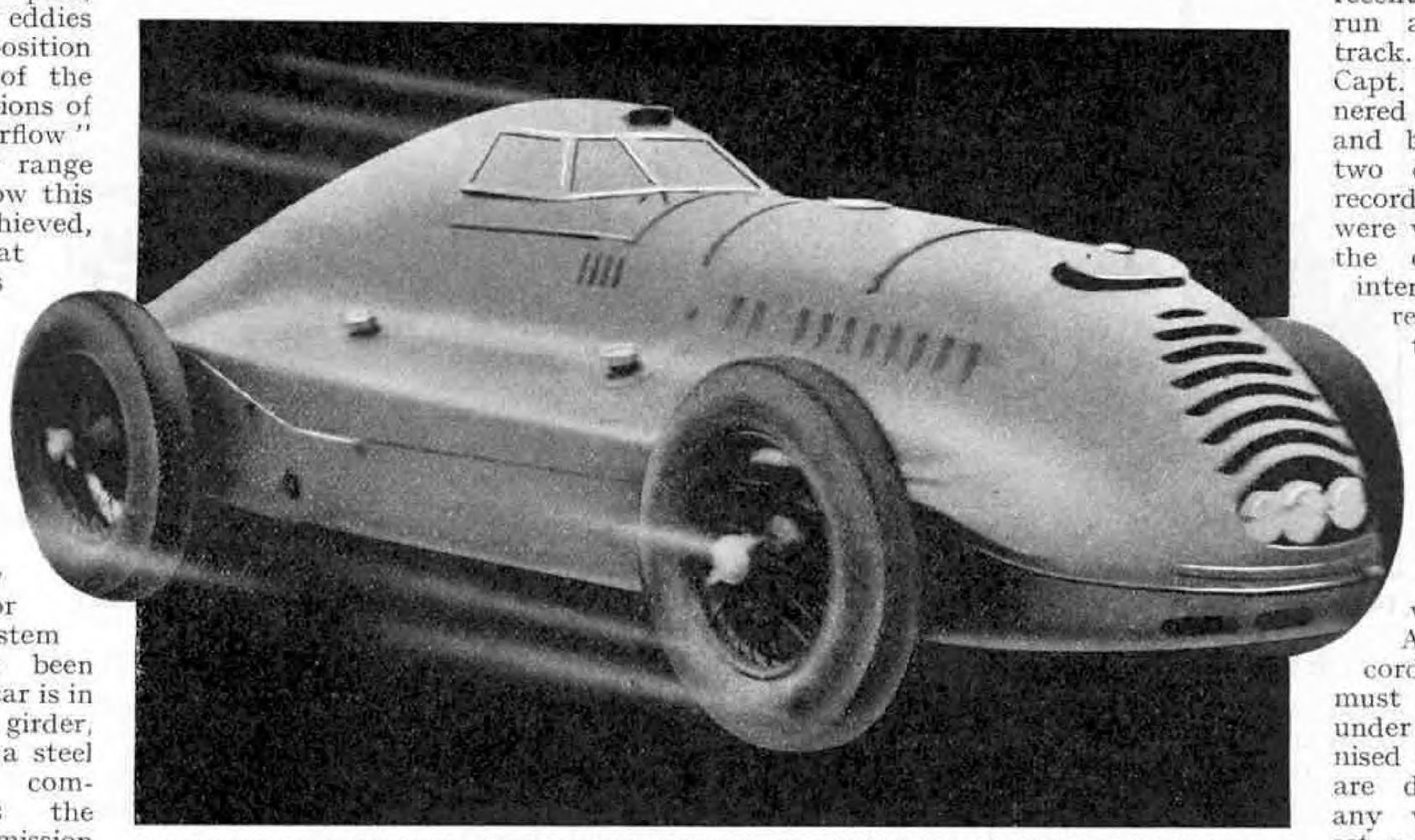
There are several other interesting features of the new Chrysler Airflow cars. For instance, owing to the novel design adopted, the widest part of the body is half way between the front and the rear axles. This is the position occupied by the front seat, and it is therefore capable of accommodating comfortably two passengers in addition to the driver. The engine is directly over the front axle and the rear seat is well in front of the back axle.

New Lap Record at Brooklands

The lap record at Brooklands made in 1932 by the late Sir Henry Birkin withstood for two years every attack made upon it, but the circuit of this famous track was covered on Easter Monday by Mr. J. Cobb in 3/5ths of a second less than the time taken by his predecessor. This raised the record for the lap to 139.71 m.p.h., against Sir Henry's speed of 137.97 m.p.h. Electrical timing was used, the mechanism being operated by the momentary eclipse of beams of invisible infra-red light as the car crossed the starting and finishing lines.

The car in which the new record was made was the 400 h.p. Napier "Railton." The conditions during the successful attempt were not too favourable, for a strong wind blowing across the track threatened to sweep the tail wheels of the car upward and to hurl the vehicle over the top of the banking, and Mr. Cobb actually was fighting hard to keep the immense car in perfect control rather than to increase the speed. At one point his instruments showed that he was travelling at more than 160 m.p.h., but his effort would have ended in disaster if he had tried to maintain this speed throughout the run.

One of the accompanying illustrations shows Captain G. E. T. Eyston at speed in the two-litre Hotchkiss car in which he made his recent record-breaking run at the Montlhéry track. On this attempt Capt. Eyston was partnered by Mr. A. Denly, and between them the two drivers broke 12 records. Three of these were world records, and the other nine were international class records. Records of the first type are those made in a motor car without any limitation of engine size, while international class records are restricted to cars with engines of various sizes. Attempts on records of either class must be carried out under a set of recognised rules, and if these are departed from in any way, any figures set up are ignored. It is, of course, possible for a car to set up more than one record on the same run.



A monster of the racing track. The streamlined single-seater Hotchkiss in which Captain G. E. T. Eyston, the famous British racing motorist, recently set up three world long-distance records on the Montlhéry track, near Paris. Photograph by courtesy of C. C. Wakefield & Co. Ltd., makers of Castrol oil.

Capturing Long-Distance Speed Records

The most important of Captain Eyston's achievements was the capture of the 48-hour world record, which was gained with an average speed of 95.36 m.p.h. The other two world records were for 4,000 m., gained with a speed of 95.76 m.p.h.; and 5,000 m., this distance being covered at a speed of 94.73 m.p.h.

These records had scarcely been made when they were shattered by four French motorists, Mm. Quatresous, Fromentin, Wagner and Besthelon. Driving a Renault on the Montlhéry track these four drivers covered a distance of 4,994 miles in 48 hours, their average speed being 104.04 m.p.h., nearly nine m.p.h. higher than that of the British drivers. The existing records for distances of 4,000 m. and 5,000 m. were beaten by similar margins, these distances being covered at speeds of 105.59 m.p.h. and 103.92 m.p.h. respectively, and in their great run the French drivers created new records for eight distances between 2,000 m. and 5,000 m., in addition to covering the greatest distances ever travelled on road or track in 24 hours and 48 hours.

Six new international records for cars with engines of between 750 c.c. and 1,100 c.c. were set up in March by Mr. R. T. Horton, a British driver, in a supercharged 1,100 c.c. M.G. Magnette. The records were for 50 km. and 50 m., distances covered at speeds of 114.84 and 115.89 m.p.h., respectively; one hour, at a speed of 117.03 m.p.h.; and for 100 m., 100 km. and 200 km., the speeds for these distances being 116.32 m.p.h., 116.86 m.p.h., and 117.02 m.p.h. respectively. All these records were previously held by Mr. H. Widengren, who made them in his Amilcar at Montlhéry.

Mr. Horton is one of the best-known British racing drivers. His most meritorious feat was accomplished in 1932 when, in an M.G. Midget, he won the British Racing Drivers' Club 500-mile race at Brooklands, which is acknowledged by drivers of all nationalities to be the fastest long-distance track race held anywhere in the world.



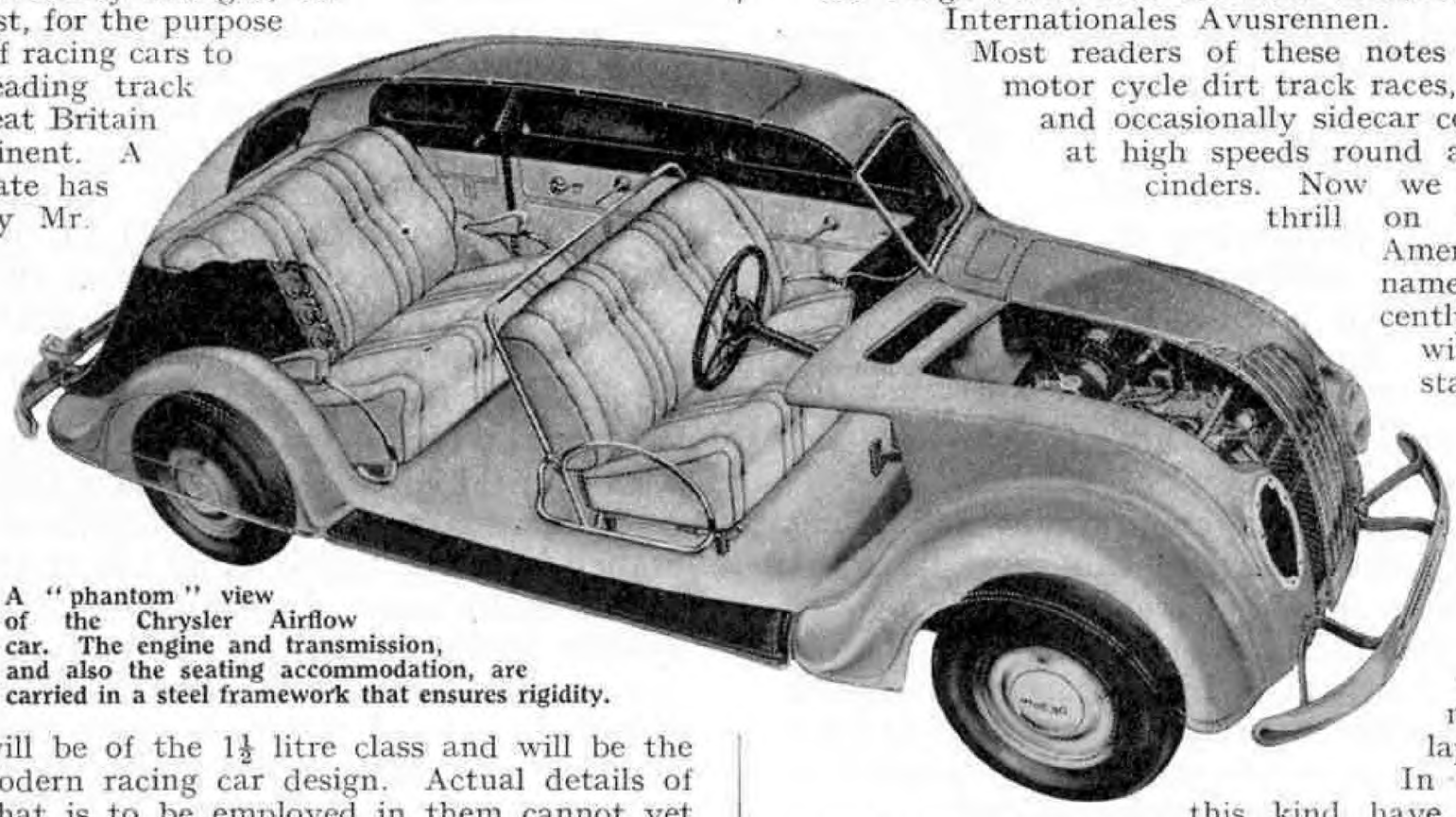
The Chrysler "Airflow Imperial Eight" town sedan, the new streamlined motor car described on the opposite page. We are indebted to Chrysler Motors Ltd., for the illustrations on this page.

It is unfortunate that Mr. Jack Field's attempt to set up a European speed record at Southport in the "*Silver Bullet*" was not successful. Mr. Field was very unlucky both in regard to the condition of the sand on the course and the weather, but on his final attempt he succeeded in attaining a speed of 154 m.p.h. for one run. On the return journey, however, he did not attain such a high speed, the average for the two runs being 140.47 m.p.h. The European record for the double run stands at 174.85 m.p.h.

Spectators who had gathered in the hope of seeing Mr. Field make racing history had their disappointment somewhat lessened by the fact that one record was created at the meeting. This was the British flying kilometre record for sidecar combinations with engine capacity up to 1,000 c.c. The existing record was 90.89 m.p.h., and Mr. C. J. P. Wood set up a new figure of 94.6 m.p.h.

Another Racing Syndicate Formed

In our issue for March last I mentioned a syndicate that has been formed by Mr. Whitney Straight, the famous racing motorist, for the purpose of organising a fleet of racing cars to take part in the leading track and road races in Great Britain and on the Continent. A second racing syndicate has now been formed by Mr. Raymond Mays, Mr. Humphrey Cook and Mr. Peter Berthon, and this is to operate under the name of English Racing Automobiles Ltd. Its headquarters are at Bourne in Lincolnshire, and it is to construct the cars that will form its racing fleet. Five of these cars are to be built. They will be of the 1½ litre class and will be the very last word in modern racing car design. Actual details of the type of engine that is to be employed in them cannot yet be given, but in order to enable the cars to take part in races this year an entirely new unit is not to be designed, a six-cylinder engine that has proved its powers in the past being slightly modified and improved for installation in them. The engine will be provided with a Jamieson supercharger and an Armstrong Siddeley pre-selector gear-box.



A "phantom" view of the Chrysler Airflow car. The engine and transmission, and also the seating accommodation, are carried in a steel framework that ensures rigidity.

The cars constructed are to be tried in the Isle of Man races at the end of this month, and also in the contest for the British Empire Trophy and the hill climbing competitions at Shelsley Walsh. If they prove satisfactory they will be entered in a number of Continental races and trials, and will make attacks on international records in the 1,500 c.c. class.

It is particularly interesting to find that the cars of the syndicate are to be provided with pre-selector gear-boxes. These units are becoming increasingly popular with racing motorists. Sir Malcolm Campbell employs one in his famous "*Bluebird*," as also does Mr. E. R. Hall in his M.G. Magnette, which is often to be seen at Brooklands. Mr. Whitney Straight also uses one in the Maserati in which he competed in the Grand Prix de Monaco on Easter Monday. This contest is known as the "Race of a Thousand Corners," for it is run over a course measuring less than two miles in length through the streets of Monte Carlo. The course is covered 100 times. It is so tortuous that it is said some drivers never succeed in engaging top gear, and their hands become blistered from their repeated handling of gear levers. It is on trying courses of this kind that the Wilson gear-box will show to best advantage, for it saves time in gear changing and reduces fatigue.

By the way, I recently heard of a novel and amusing instance of the value of a self-changing gear-box. Two armed men who had carried out a "smash and grab" raid in Ireland, and were making off with more than £300 in notes and silver, decided to borrow a 15 h.p. Armstrong Siddeley car they saw by the roadside. On getting inside they were unable to discover the gear lever! Their ignorance of the working of the pre-selector gear-box fitted to this car led to disaster, for they wasted so much time looking for the non-existent lever that pursuing police and civilians were able to overtake them, and their exploit ended ignominiously in the police station!

Coming Events in the Speed World

This month will be a busy one for racing motorists in all countries, for many important races take place. For instance, in Great Britain the Isle of Man races will be held at the end of the month, while the Brooklands Automobile Club is holding an important meeting on the 21st. In France there are the Rally International du Maroc, the Grand Prix de Casablanca and the Grand Prix de Nimes; in Italy the Grand Prix de Tripoli, the Targo Florio and the Tour d'Italie; and in Germany the Internationales Avusrennen.

Most readers of these notes will be familiar with motor cycle dirt track races, in which motor cycles, and occasionally sidecar combinations, are driven at high speeds round a track made of loose cinders. Now we are to have a new thrill on these lines, for an American dirt track driver named Alvin Rhiando recently came to England with the intention of staging a series of dirt track races for motor cars. The speeds attained at such meetings are, of course, far in excess of those possible on motor cycles, the cars often maintaining an average lap speed of 100 m.p.h. In the past, meetings of this kind have been banned by the Royal Automobile Club, but the ban has now been lifted.

Accessories of all kinds are used on motor cars, and many that were at one time bought as luxuries are to-day almost standard equipment. This appears to be the case with radio, for while two years ago probably not one car in the country was fitted with a radio set, now many manufacturers fit aerials in their new models.

The method of operating a radio set installed in a motor car is interesting. In most cases Bowden wire cables connect the controls on the set to remote controls mounted on the steering column. British Radiophone Ltd., however, have produced a unit that is far more efficient in operation. This is a complete miniature tuning unit, with very small ganged condensers, a wave-change switch, a volume control and an on-off switch. The complete unit is small enough to be mounted on the steering column!


EGGS OF REED WARBLER

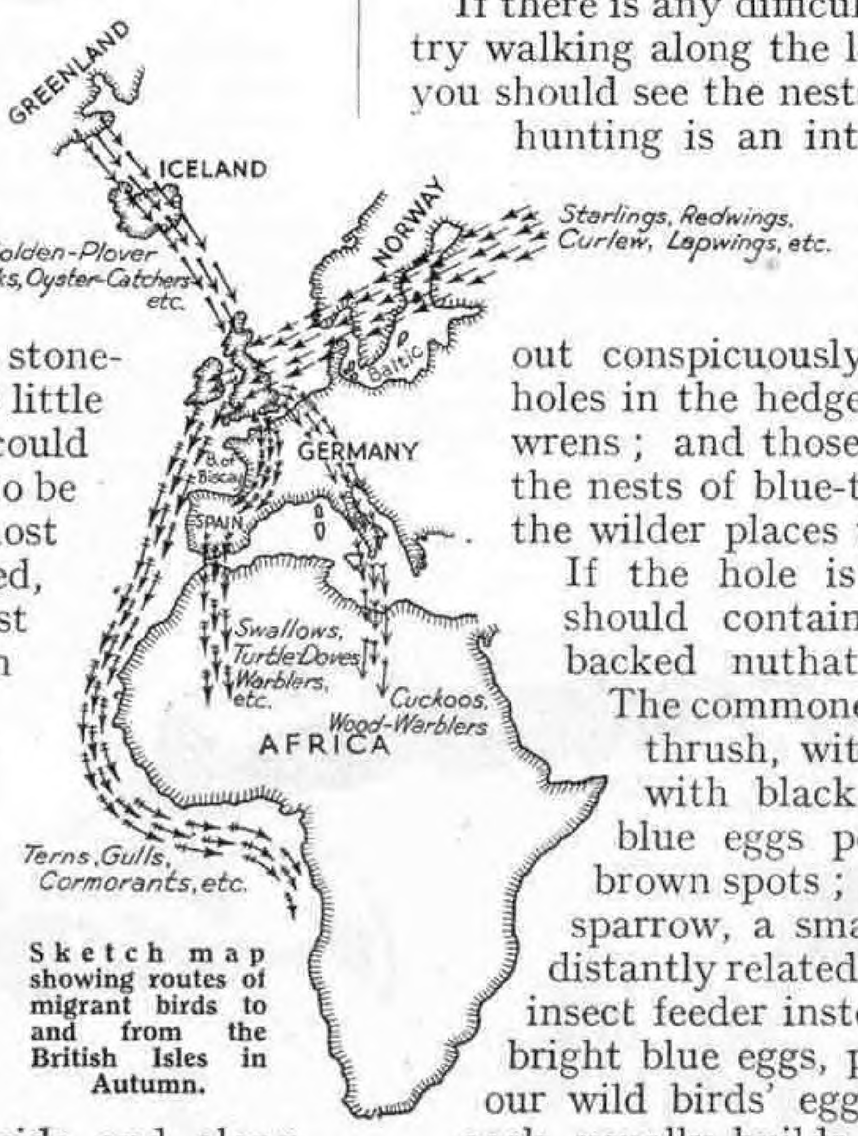
The Fascination of Bird Watching

OUR SUMMER AND WINTER MIGRANTS

by *Eric Hardy*


HERON FISHING

THERE was once a small boy living in Provence, in France, who climbed to the top of a lonely hill and there disturbed a bird from beneath a stone at his feet. The bird flew a few yards away, perched on another stone and called " chack, chack," and the boy saw that it was a little short-tailed, robin-like bird with a glossy black head, a snow-white collar, and a bright orange chestnut breast. Under the stone where the bird had appeared the boy found a nest, a mass of hairs and straws, containing six pretty blue eggs. Full of this the boy rushed off to his friend the priest, and described his adventure. The priest told him that the bird was a stone-chat, and urged him to go back when the little birds had hatched, and observe all he could about their daily life. This boy grew up to be Jean Henri Fabre, one of the world's most famous naturalists ; and just before he died, in 1915, he recounted this story of his first bird's nest as the happiest discovery in his life.



Sketch map showing routes of migrant birds to and from the British Isles in Autumn.

Considerably more than 10,000 different forms of birds exist in the world to-day, and the bird population is something like 75,000 millions, or nearly 40 times the total number of human beings. In England and Wales alone there are some 80 million birds of over 400 kinds. There are birds everywhere—in the heart of cities, as well as in the open countryside and along the sea coast—and there is no occupation more fascinating than the watching of these feathered folk.

The art of bird-watching is free to all, there is no bar to its apprenticeship. A new book I have just read tells all about this art, and unlike so many bird books it is very useful because it tells how not to watch birds, which is a very important point. It is interesting to find a bird's nest in the hedgerow, but when half-a-dozen or more nests have been discovered the interest wanes, and one's searches become like tiresome school lessons. Why not stop at the first nest you find, hide yourself in a shaded spot, and watch for the return of the owner ? See what food she brings, count how many times she comes, and note whether both parents take a share in the task of feeding the young ones. If there are eggs, and the bird is sitting, see how many days it takes for the eggs to hatch, and then for the chicks to leave the nest. Just before the chicks leave—and this is specially interesting when the nest is in the garden—tie a piece of red cotton or wool on one leg of each youngster, so that you can recognise them when you see them in the trees. They will probably leave the garden in the winter, for all young birds move away from their nests about a fortnight after becoming fledged, so watch for their coming back the next spring.

If there is any difficulty in finding nests in a hedgerow, try walking along the lower side of the hedge, and then you should see the nests outlined against the sky. Nest hunting is an interesting pastime in the autumn also, for when the leaves have fallen and the trees and bushes are left bare, many nests that were hidden in summer stand out conspicuously in the branches. Search the holes in the hedgerows for the nests of robins and wrens ; and those in tree branches and trunks for the nests of blue-tits, starlings, woodpeckers, or in the wilder places the brown-headed tree sparrows. If the hole is plastered round with mud it should contain the nest of the little blue-backed nuthatch.

The commonest nests in hedges are those of the thrush, with four or five blue eggs spotted with black ; the blackbird, with greenish blue eggs peppered all over with red and brown spots ; and nearer the bottom the hedge sparrow, a small grey-headed brown bird only distantly related to the common sparrow, being an insect feeder instead of a grain feeder, which lays bright blue eggs, perhaps the most beautiful of all our wild birds' eggs. The misselthrush, or storm-cock, usually builds in the fork of a tree, where the branch joins the trunk ; and the chaffinch builds a moss nest liberally covered with white and grey lichens on the outside, resting on some flattened fork towards the end of one of the lower branches. A cuckoo's egg is usually slightly larger and darker than the others, and is generally found in the nests of larks and pipits, which lay small dark-coloured eggs in their nests in hollows in the meadow grasses, often beneath a tuft of grass.

The choice of place for your bird watching is important. You must not expect to see much in the woods in winter, but in summer they are perhaps the richest of bird haunts. The same applies to the large stretches of sandhills, where the gulls and terns or sea-swallows nest ; but wherever there is water, be it lake, river, marsh, or the sea, you will always find birds. Birds must have water. If you watch the singing blackbird you will notice how every now and then he slips down to the river for a drink, to " wet his whistle " as country folk say ; and water

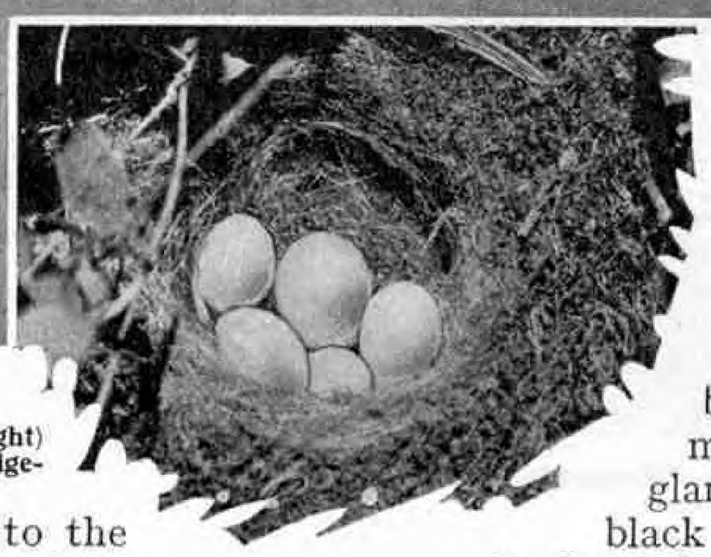
draws the birds to a district like a magnet. In winter some large quiet inland lake, or the seashore, are the best of all places for bird-watching. Let us look at an inland lake in winter.

Before starting we will equip ourselves with field glasses, a notebook, and a small handbook on British birds, illustrated with sketches and a few coloured pictures. Field glasses are not absolutely essential, but as wild birds will not always wait for one to come up and watch them at close range, they enable us to see many things at a safe distance. Prismatic glasses are less bulky than the ordinary type, and × 8 is the best magnification power. Anything higher is too powerful for bird-watching, for one cannot hold the glasses steady enough to see a small bird sharply defined, or focus them quickly as a bird suddenly flies up and is winging its way out of view. Arriving at the lake we notice from a distance the flocks of wild ducks that are collected on the open water. We can hear their callings long before they come into view. Very few are "quacking"; many are whistling, others are making a harsh "carr" like a crow, and still others a noise like the "ping" of an air gun. As a matter of fact very few ducks, except the common wild duck or mallard, "quack," and our association of quacking with ducks is due to the fact that the common farmyard duck is a tamed variety of this common wild duck.









(Top) Black Headed Gull. (Left) Jay. (Right) Curlew. (Bottom) Cuckoo's Egg in Hedge-sparrow's Nest.

We do not walk straight up to the edge of the bank, for that would immediately alarm the birds and send all the flocks up into the air, when they would fly away to another water. Tucking out of sight all white pocket handkerchiefs, pulling stockings over bare knees, and raising coat collars over white collars so as to make ourselves as inconspicuous as possible, we take up our position in the shelter afforded by the evergreen bushes at the edge of the lake. This is our "hide," and one can always see more birds during half-an-hour's sitting in one spot than in rambling for an hour over the countryside. We have opened our book at the section on wild ducks, because we know these are the commonest birds on the lake in winter, and the other birds follow on in the next pages.

The flocks on the big open water have not noticed us, and in a few minutes odd birds are swimming directly towards us. They are in pairs, some brown, others gaudily coloured with glossy blue-green necks, chestnut-brown breasts, and silver-grey backs, and through the glasses we notice a beautiful blue bar across the wing. They are the most wary of all the ducks on the water. They seem to act as watchmen for the others, and at the least suspicion they leap into the air, quacking loudly, and fly round in increasingly large circles. This quacking, and the gaudy colours of the drakes, enable us to recognise them as common mallards. But why should they be in pairs, and in their handsomest plumage, in winter? The reason is that the ducks are the earliest of birds to pair, and as early as November the drakes have moulted into their courting plumage. In June, when the young ducklings or flappers are hatched, the drake mallard loses all his gaudy feathers, and becomes as sober in colour as his mate.

There are other birds on the water coloured like the drake mallard, except that their sides have a large amount of white on them, and through the glasses their large spatulate beaks make them very conspicuous. They are the shoveller ducks, their unusually shaped beaks being designed to sift the mud from the bottom for insects and shells; and when they fly, calling "puck puck," the white in their plumage is more noticeable than before. Among the big flocks of duck we may see many that are jet black with glaringly white sides and a long black tuft hanging down from the back of the head. They are tufted ducks which, like the shovellers, are becoming more abundant and taking to nesting in increasing numbers in the summer. There are also flocks of pochards, ducks that have chestnut heads and jet black breasts; widgeon, with a yellow crown to their chestnut heads; and here and there an odd party of pintail, so called because of the long slender feathers of their tails, and which possess also a thin white line reaching up the long neck to the eyebrow.

Some black birds which, like the ducks, are constantly diving, with white beaks and a large white shield on the forehead, are coots, birds that make a sudden cry like the "ping" of an air gun. Similar but smaller black birds with a scarlet beak, that swim across the water with jerking heads, are waterhens or moorhens. The call of the moorhen is often heard when the bird is hidden in the reed beds; it is like a sudden loud "keckup." Kingfishers, too, may be seen fishing, especially if the lake is near the coast. In September many of the kingfishers migrate from the rivers down to the salt marshes and

waters near the coast, journeying back inland in March. Last winter, on a lake a few miles from the sea, I used to watch a kingfisher who passed me in my hide exactly an hour before dark every day I was there. I found his fishing perch on an island in the middle of the lake, and his roosting perch among the warmth of the thick leaves of a rhododendron on the banks. Luckily my hide was between these, and his passing was so regular that I took it as my time to leave.

Now let us pay a visit to the coast, and this time we will take with us a telescope and mount it on the cliffs. On the edge of the waves there are flocks of thousands of birds, most of which have come down from the Arctic. They are more numerous than in summer, but as the seashore is so open we cannot get very near without disturbing them. Through the telescope, however, we find no less than six kinds of seagull. Some have their backs and wings jet black, and our book describes them as the greater and lesser black-backed gulls. They have bright yellow beaks and feet, as have some other big gulls, the herring gulls, with grey instead of black on the back, and which are calling very loudly "ak-ak-ak-ak." The little gulls with red beaks and feet are the black-headed gulls, though their heads are now white like the rest of their feathers, for their black head lasts only during nesting time. The kittiwakes are very graceful birds with black feet and greenish-yellow beaks; the common gulls have green feet and beaks.

Descending from the cliffs, we walk out towards the edge of the tide to watch the birds in flight. The great flocks of waders fly off with piping cries as soon as we appear on the beach, and the first to fly up are the redshanks, long-legged waders whose piping runs of calls are the alarm signals to the other birds. Just as in summer the screech of the jay gives the alarm to the birds in the woods, the harsh clatter of the blackbirds the warning to the birds in the hedgerow, and the wailing cry of the peewit plover in the meadow to the birds that gather there, so the cry of the redshank is the recognised alarm signal on the seashore. A group of sandy-brown birds that have risen to our right with a quieter whistle like "tirrrr" are the little ringed plovers so common on all the shores. Their heads and breasts are black, and they have a white forehead and collar.



(Top, left) Thrush. (Top, right) Kingfisher. (Centre) Cormorant. (Bottom) Cuckoo.

The large black-and-white birds we see in the distance, which never allow us to approach too near, and which are noticed to possess long sealing-wax-like red beaks and legs, are the oyster-catchers. When the oyster-catcher flies towards us the white on its breast and wings forms the shape of a cross. In the Hebrides there is a legend that Christ once visited Scotland and when fleeing from His enemies was covered with seaweed and hidden by the oyster-catcher; and that on another occasion when two children were cast adrift on the sea, and their lives were in danger, the oyster-catcher brought the news to St. Bride, who saved them. Therefore, the fishermen tell us, St. Bride gave the oyster-catcher its white cross.

Where the pools of water have collected on the sands stand large brown birds with long curved beaks probing into the soft sand. These are the curlews, which can be seen everywhere when the tide is out. On the wing they often fly in a V shape, like the wild ducks and wild geese, calling a bubbling cry of "currr-loooe." Sometimes they fly overhead so swiftly that the whistle of their wings is audible below; but at other times, especially when flying alone, they travel almost as slowly as the rook, one of the slowest of fliers.

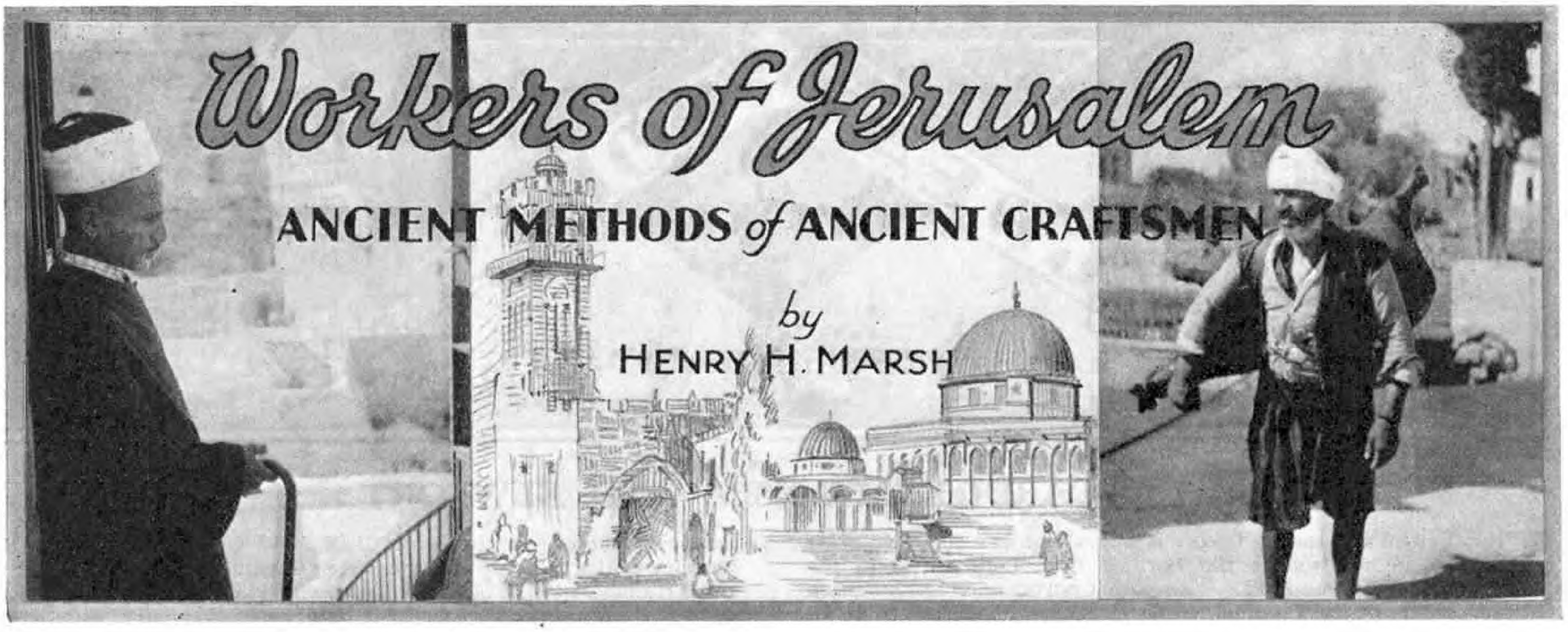
These are only a few of the birds you may see on a typical winter visit to the lake or the shore. In spring and in autumn the migrating season is at its height; from March to May the birds are nesting, and nests and eggs are common; by June the last of the eggs should have hatched; and in late June and July young birds are very common about the countryside, noticeable by the shortness of their tails, their confidence in one's approach, and their usually cheeping cries when older birds are near. With July comes the great moulting season when the birds suddenly become silent after reaching the climax of their song in May. Late July sees the first of the summer migrants, mostly young birds winging south. At night in autumn and winter listen for the faint cries of migrating birds coming occasionally out of the inky blackness overhead. They are the calls of the leaders of the flocks keeping the birds together in the dark.

At migrating times it is most useful to keep a list of the days when one sees one's first or last cuckoo, swallow, and so on, and to compare the list with that of a friend at the seaside to see whose birds come first. Our bird migrants travel south from England by three great routes, and our winter visitors arrive by two main routes. The most important route south, followed by swallows, warblers, turtle-doves, and—as far as France and Spain only—by pipits, wagtails and thrushes, is down the west of France and Spain, across the Mediterranean at the Straits of Gibraltar, and across the Sahara to Central and South Africa. The second route, followed by terns or sea-swallows and other sea birds, is across the Bay of Biscay, passing Spain and Madeira, and round the West African coast down to the Cape. The third route to the south, which as yet is but little understood, though it is known to be followed by cuckoos and wood warblers, takes the birds east through Germany, down Italy, across the Mediterranean near Malta, and so into Central Africa.

The main routes for the arrival of winter visitors, such as starlings, redwings, fieldfares, curlews, plovers and woodcock, is from Scandinavia and the Baltic shores, across the North Sea, arriving on the east coast. Many of the birds continue to Ireland. Various wild duck, golden plover and oyster-catchers come from their Iceland or Greenland homes via the Faroe Islands and North Scotland.

On the southern shores of the Baltic Sea in the middle of the great migration route from the North is situated the Rossitten Bird Observatory, where German naturalists keep watch and record of the migrating birds, marking hundreds with little numbered metal rings in order to trace their routes and countries of origin. A short stay at one of the lighthouses round our coasts in October or November is full of interest, for never a night passes without thousands of birds on migration being attracted by the glaring light. The Royal Society for the Protection of Birds now erect perches for the tired migrants on the largest lighthouses; previous to this the keepers used to shovel away the bodies of the birds that had dashed themselves to death against the hot glass in the night. Recently a well-known bird lover made a gift of bird books to all the lighthouse keepers, and now the majority of keepers make a list each autumn of the birds they see around the light. These birds include some very unusual visitors to lighthouses, such as woodpeckers, stormpetrels, kestrels, hawks, and corncrakes.

An event of interest to bird students all over the world will take place at Oxford University in July next, when the International Ornithological Congress holds its eighth conference. This will be the first time since 1905 that the Congress has met in this country, and it will be notable as the occasion of the official opening of the new British Institute for Ornithology at Oxford. The Institute will form a centre for all British bird students, and will play an important part in organising their activities.



THE activities of the workers of Jerusalem are numerous and varied, and some of their tasks are still performed by methods that have been employed for many centuries. The craftsmen of the markets can be seen at work slowly creating masterpieces in brass or copper with simple tools no different from those used by the craftsmen of long ago; and the more exacting work of carving beautiful specimens in olive wood, calling for extreme skill in design, is similarly carried out. These beautiful carvings in olive wood are exhibited in the shops of both the old and new parts of Jerusalem, where they ultimately attract the eyes of the numerous tourists and others who visit Palestine during the Spring months of the year.

In this article, however, we are concerned with the more common workers of the city, who are just as skilled in their particular jobs as the craftsmen just referred to. The gradual modernising of Jerusalem is slowly reducing the number of these callings. Many of the native water carriers, for instance, have lost their jobs through the recent completion of a huge reservoir that is fed from a natural supply near the Dead Sea. Before the opening of this reservoir water was a commodity all too scarce in Palestine, and the water carriers of Jerusalem made many journeys with their wet loads between a well in the area of the Mosque of Omar and the houses of wealthy Arabs who lived in the old part of the city. The water carrier bearing his water-filled pigskin, shown in the right illustration in the heading, was on his last trip when I took the opportunity to photograph him.

Ice-cream is naturally very popular in such a warm city as Jerusalem, and the Arab ice-cream vendor is an extremely busy person. The "delicacy" that he sells, however, is very different from the excellent ice-cream sold in this country, and I would certainly not advise English visitors to sample the native ice-cream unless they specially desire a minor pain or two in their inner regions afterwards! The Arab makes his horrible-looking mess of cream by adding goats milk to very inferior powder that he buys for the purpose by the sackful in the old part of the city. He then mixes the lot together with a stick, and applies ice that has been ground into small pieces. The result is a mass of creamy substance called "ice-cream" that is greatly enjoyed by the Arab peasants among whom the vendor usually establishes his pitch. Even if the peasants were aware of the method of manufacture, it would not make the slightest difference to their liking for the stuff, thanks to their hardy digestive organs.







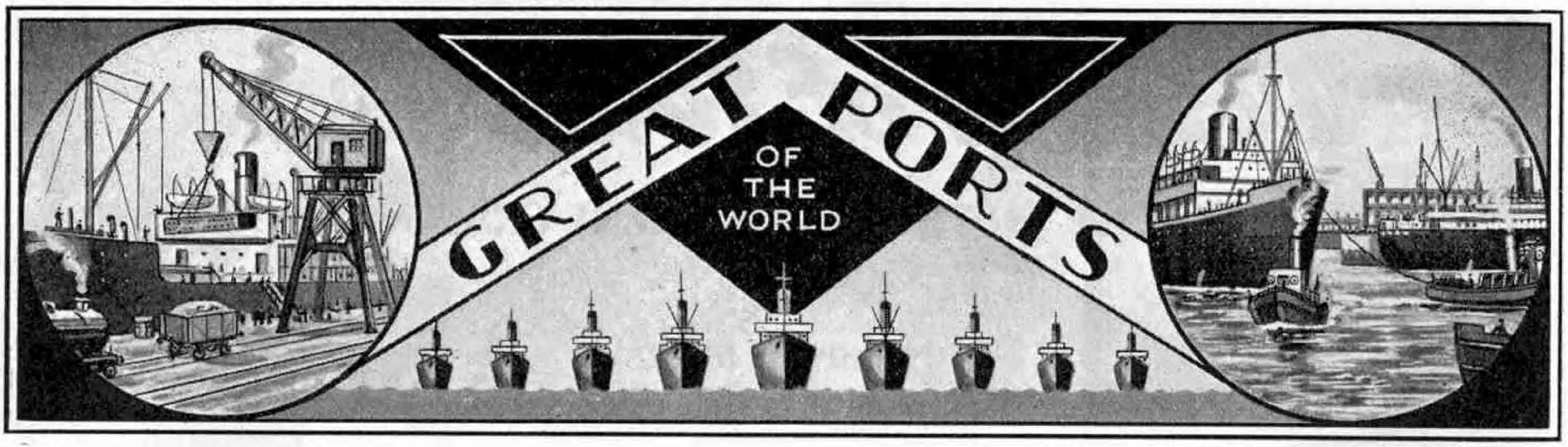
(Top) The ever popular ice-cream vendor. (Centre) Tile maker at work. (Bottom) A dresser of stone.

Very little machinery is installed in the tile-making factories in Palestine, and even that is of the most simple character. All the finishing-off work is done by hand, and in consequence the tiles are much more expensive than those exclusively made by machinery. As a rule only primary colours are used for the hand-finished tiles, but they are cunningly blended by means of blocking and casting. The moulds are filled with the dyes, and by a single operation the Jewish tile maker recovers from the simple machine the finished product, a fine example of his skill. The tiles, properly fixed in a cement "bedding" on the floor of a house, are practically everlasting, and only time causes their colours to fade.

Another interesting native worker of the Holy City is the Jewish dresser of stone. No stone-dressing machinery has yet been installed in the city, and the Arab sits all day under his improvised sun-shelter, tapping away with hammer and chisel at the undressed stone blocks that lie all around him. He reminds one of the members of a quarry gang whose misdeeds have earned them a term of "hard labour," but he is only another of Jerusalem's honest breadwinners, and he manages to earn a miserable pittance by hand-carving stones for the foundations and walls of houses.

The stone-dresser shown in one of the illustrations on this page was on the point of fixing up his "tent" against the sun's rays when I came across him, and he consented to pose for his picture. Few of us would care to earn our living by working like this all day under the rays of the hot sun, but he does it contentedly; a slow but sure labourer in one of the oldest industries in the land.

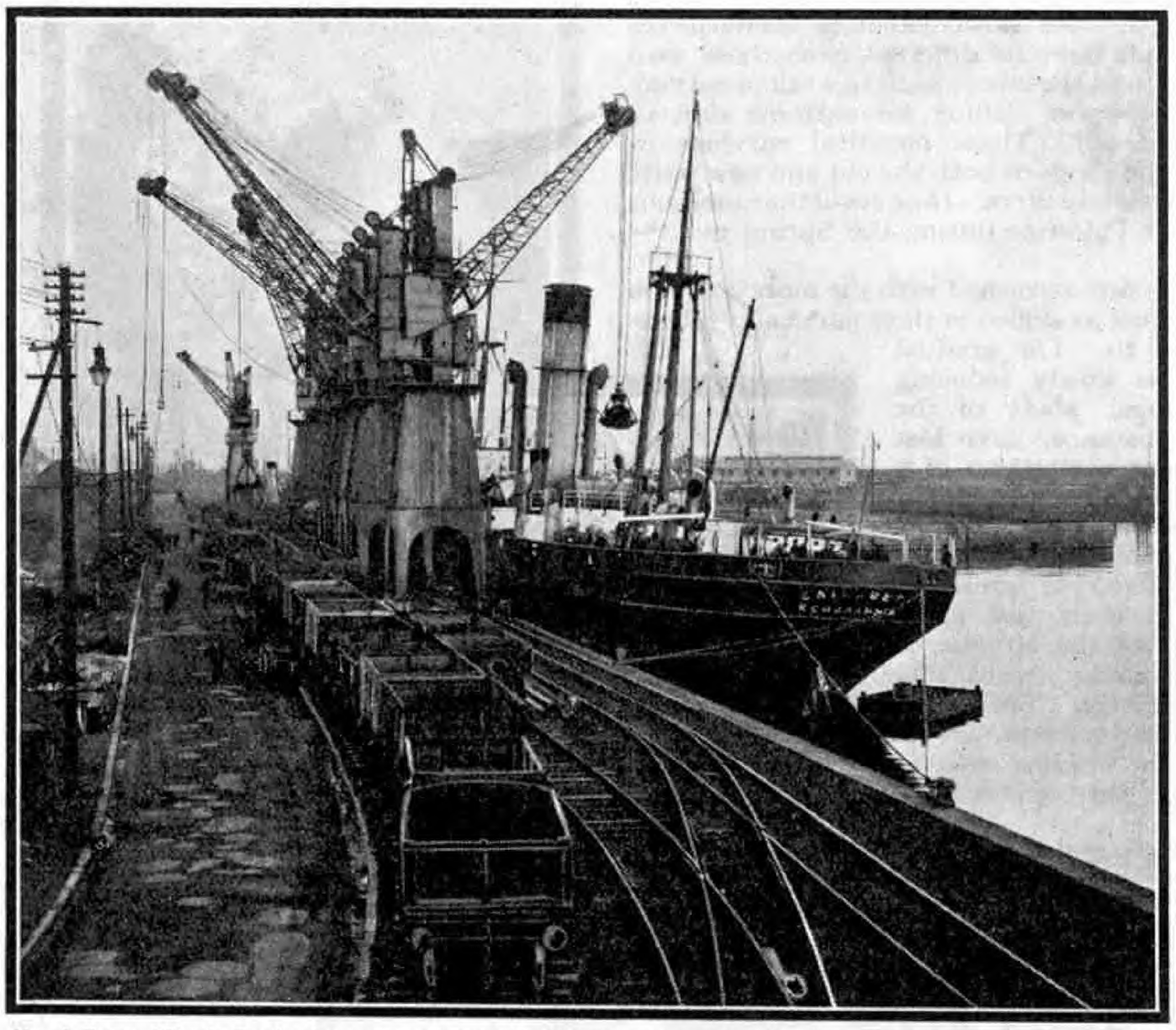
The left illustration in the heading is of a "caller to prayer," a noble profession that is distinct from the classes of workers I have described. The Arab shown is one of a family of five, all blind, who take it in turns at different times of the day to call to prayer all true sons of the Prophet.



IX.—CARDIFF, SWANSEA AND NEWPORT

THE Bristol Channel is to-day a water highway to other great ports in addition to the Port of Bristol, described in the *"M.M."* of June 1932. These other ports are on the northern or Welsh side of the Channel, while Bristol is on the southern or English side. Starting from the upper or eastern end of the Channel we have Newport, Cardiff, Penarth, Barry, Port Talbot and Swansea, together forming a group of some of the finest ports in the world; and in addition there are smaller ports such as Llanelly and Burry Port.

The creation of this great line of docks along the South Wales seaboard was brought about by the existence of the South Wales coalfield so near to a coastline offering the possibilities of making harbours. The shipment of coal from South Wales began on a systematic scale about 130 or 140 years ago. In the very early days the coal was brought down from the collieries by mules or pack horses, each animal carrying a load of about 130 lb., and three or four of them being in charge of a woman or a boy. This method of transport was eventually followed by trams drawn on rails by horses. It is said that the introduction of these horse-drawn trams was strenuously opposed by people who lived along the track, their complaint being that the rumbling of the trains soured the beer in their cellars!



No. 4 Quay, King's Dock, Swansea, showing level luffing cranes handling cargo. The illustrations to this article are by courtesy of the Great Western Railway.

Later the demand for coal led to the construction of canals, the coal being loaded into barges at the collieries and drawn to the docks by horses. The canals may be said to have given the first real impetus to the development of the South Wales ports. As the splendid qualities of Welsh coal became better known, the demand increased, the canals soon became inadequate for transporting the required quantity of coal to the sea, and gradually they were replaced by railways. When the grouping of the British railways took place in January 1922 the Great Western Railway became the owners of the South Wales ports. In this article we shall describe the three great ports Cardiff, Swansea and Newport.

According to tradition Cardiff traded with Greece long before the first Roman invasion of Britain 2,000 years ago, and the port is also identified with the legendary exploits of the Knights of the Round Table. Authentic records of the port date from the Roman occupation, and it is believed that the name Cardiff is derived from "Castra Didii," the camp of the Roman officer Didius. In the 11th century a castle was constructed on the site of the old Roman fort by command of William the Conquerer, and in 1263 the first quay was constructed on the River Taff. By the close of the 18th century coal was being exported from Cardiff. It was brought by mule transport to the old quay, from which vessels of small tonnage carried it across the Channel to Bristol and other ports.

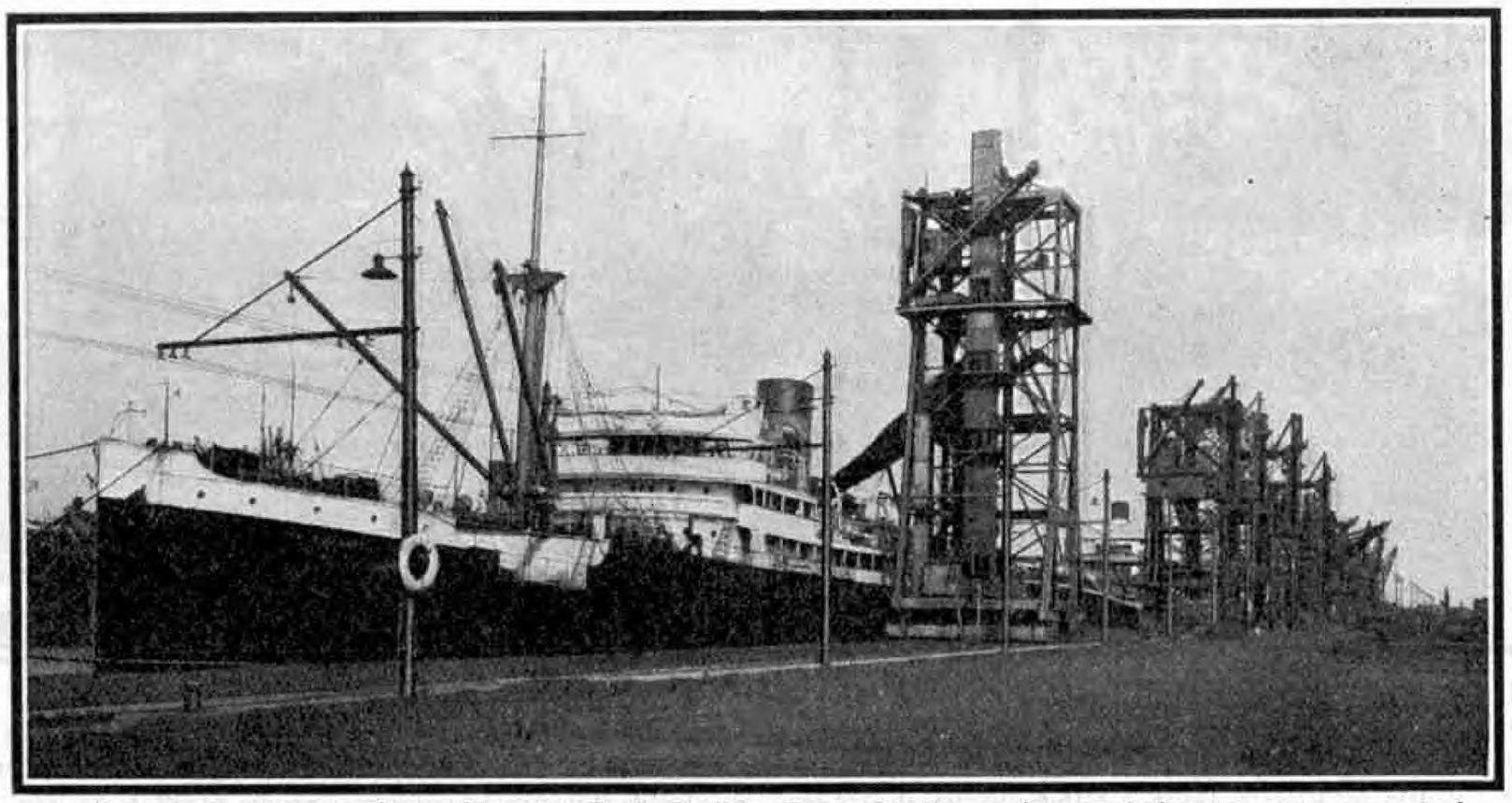
In 1789 the Glamorganshire Canal was extended to Cardiff and there equipped with a sea-lock entrance, and the extended canal provided a greatly improved means of transport for coal and iron from the South Wales valleys to the sea. Shortly afterwards powers to construct what is now known as the West Bute Dock were obtained by the second Marquis of Bute, who planned to develop Cardiff into a great seaport. The situation of the dock is a good deal above low water mark, and considerable difficulty was experienced in connecting it with the Channel, in which the difference between the height of water at high tide and low tide is 40 ft. Eventually the dock was completed, and it was opened in 1839. It is 4,000 ft. long and 200 ft. wide, and is entered from the open Channel through a basin 1½ acres in extent. The dock has 8,950 ft. of quayage and is equipped with coal hoists and hydraulic cranes.

The rapid expansion of industry was accompanied by a corresponding increase in the facilities and accommodation of the port. The opening of the Taff Vale Railway added to the volume of mineral traffic, and in addition to using the western side of the West Bute Dock the company built a dock under the headland at Penarth, where there is a natural harbour formed by the estuary of the River Ely. This dock was opened in 1863, and marked the beginning of the development of Penarth, which is now part of the Customs port of Cardiff.

The second Marquis of Bute died in 1849, but he left his estates in trust so that his scheme to develop Cardiff could be carried out; and during the 20 years after his death his trustees accomplished much in this respect. The construction of the East Dock was decided upon in 1851, and the trade of the port increased so rapidly that even while the dock was being planned it was repeatedly increased in size. It is 4,300 ft. long, varies in width from 300 ft. to 500 ft., and is entered from the sea by a basin the lock to which is 55 ft. wide. The dock and the basin have a total water area of over 46 acres. There are numerous coaling appliances, and a large number of cranes for general cargo.

A third dock was opened in 1887. This is known as Roath Dock, and is 33 acres in extent, varying in depth from 32 ft. to 37 ft.

A lock 600 ft. long and 80 ft. wide connects the dock with Roath Basin, which covers 13 acres. The dock and the basin have a total quayage of 9,885 ft., and are equipped with numerous coaling appliances, including an electric belt conveyor. The dock has also many electric and hydraulic cranes for general cargo. A junction lock communicates with the East Dock already mentioned, and the Roath Dock is also connected by a short waterway with the Queen Alexandra Dock opened by Edward VII in 1907 which is 52 acres in extent. Both this dock and Roath Dock were constructed with quay walls on all sides and form practically one dock of 85 acres, thus making one of the largest walled docks in the world. The south side of the Queen Alexandra Dock is fully equipped with modern coaling appliances, and the north side is reserved for import and general export trade.

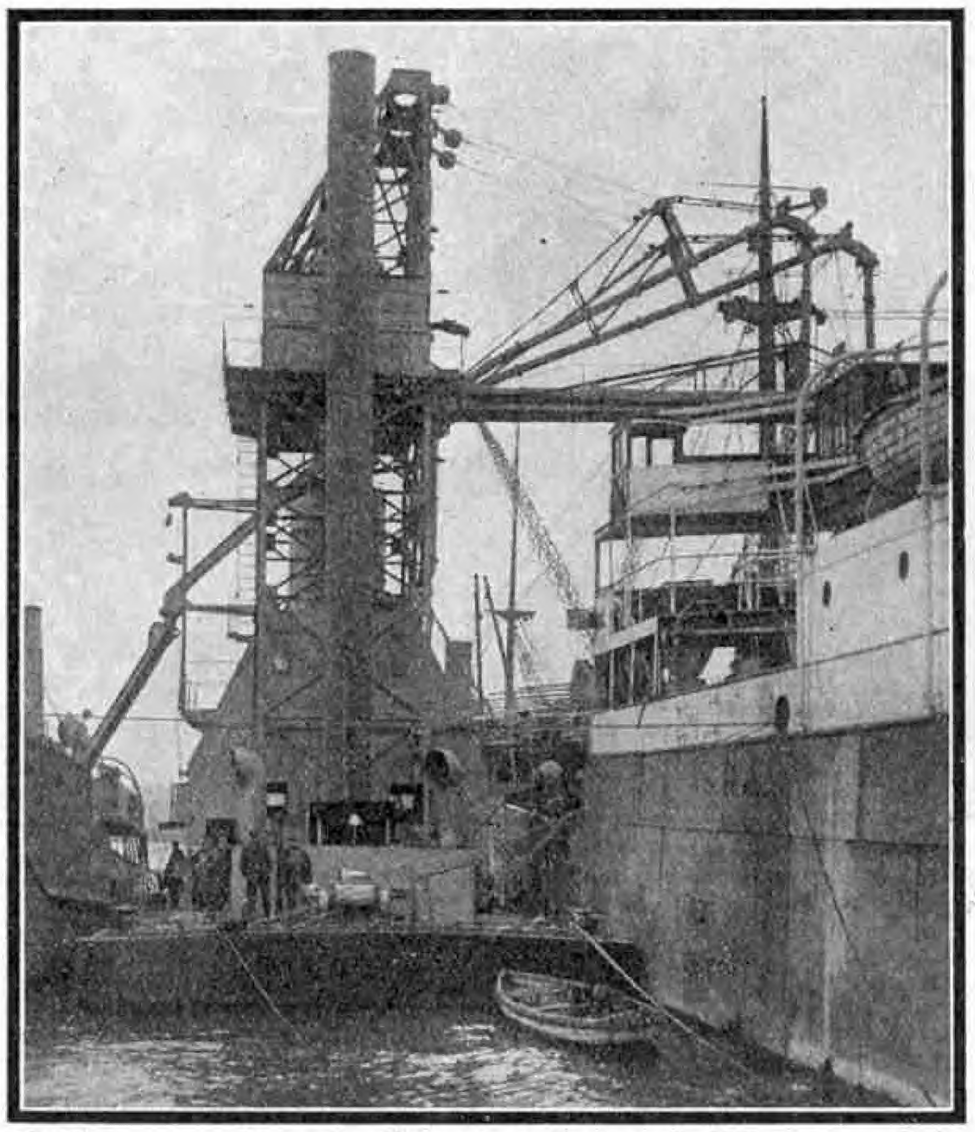


Coaling a large steamer at Queen Alexandra Dock, Cardiff. The coal hoists can be moved along the quay as required.

The dock equipment of the port includes 35 coal hoists, coaling cranes, and the conveyor just mentioned; and 18 of the coal hoists are capable of unloading 20-ton wagons. In addition there are powerful hydraulic, steam and electric cranes for dealing with general cargo, and a floating crane capable of lifting up to 125 tons, which is sent to any of the Company's principal South Wales docks when required. The 26 transit sheds and warehouses have a total area of 968,906 sq. ft., and several of them are equipped with electric conveyors, pilers and electric platform trucks to facilitate the rapid unloading of goods.

Cardiff is served by an excellent system of railways communicating direct with the great coal-producing valleys of South Wales, and with the industrial and anthracite areas of West Glamorgan. During 1933 4,574,525 tons of coal were exported from the port. Coal is only one of many commodities dealt with, however, and during a normal year more than 500,000 tons of other goods are exported. This total includes patent fuel, steel rails, iron, carriage and wagon work and general merchandise of all descriptions.

The general imports reach a much higher figure, and normally exceed 1,500,000 tons a year. Iron ore, pig iron, timber, grain, flour, frozen and chilled meat, and fruit and provisions are among the many different commodities included in this huge total. Cardiff is one of the comparatively few ports in Great Britain where live cattle may be imported, and during recent years many such consignments from Canada have been landed, sold, and distributed by rail to all parts of the country.



Floating pneumatic grain discharging plant at Cardiff Docks. It is transferring a cargo of grain from the ship on the right to a coasting steamer.

Another important branch of the trade of the port is the importation and distribution of pitwood and pit props, and this traffic amounts to about 500,000 tons a year. The timber is brought to the docks from Norway, Sweden, France, Finland, the White Sea, the Baltic, the Danube, and Canada. Large quantities of grain are also imported, and there are large mills and granaries to accommodate it. The G.W.R. floating elevator can discharge 120 tons of grain per hr. from a ship's hold direct to warehouse, truck, or to barges alongside.

Cold stores are an important feature of all modern ports, and those at Cardiff have a storage capacity of 300,000 cu. ft. They are situated at the Queen Alexandra Dock, and are equipped with all modern appliances and with electric lifts to all floors. The largest ships can berth alongside, and meat, etc., can be discharged direct from ship to store or into refrigerator vans.

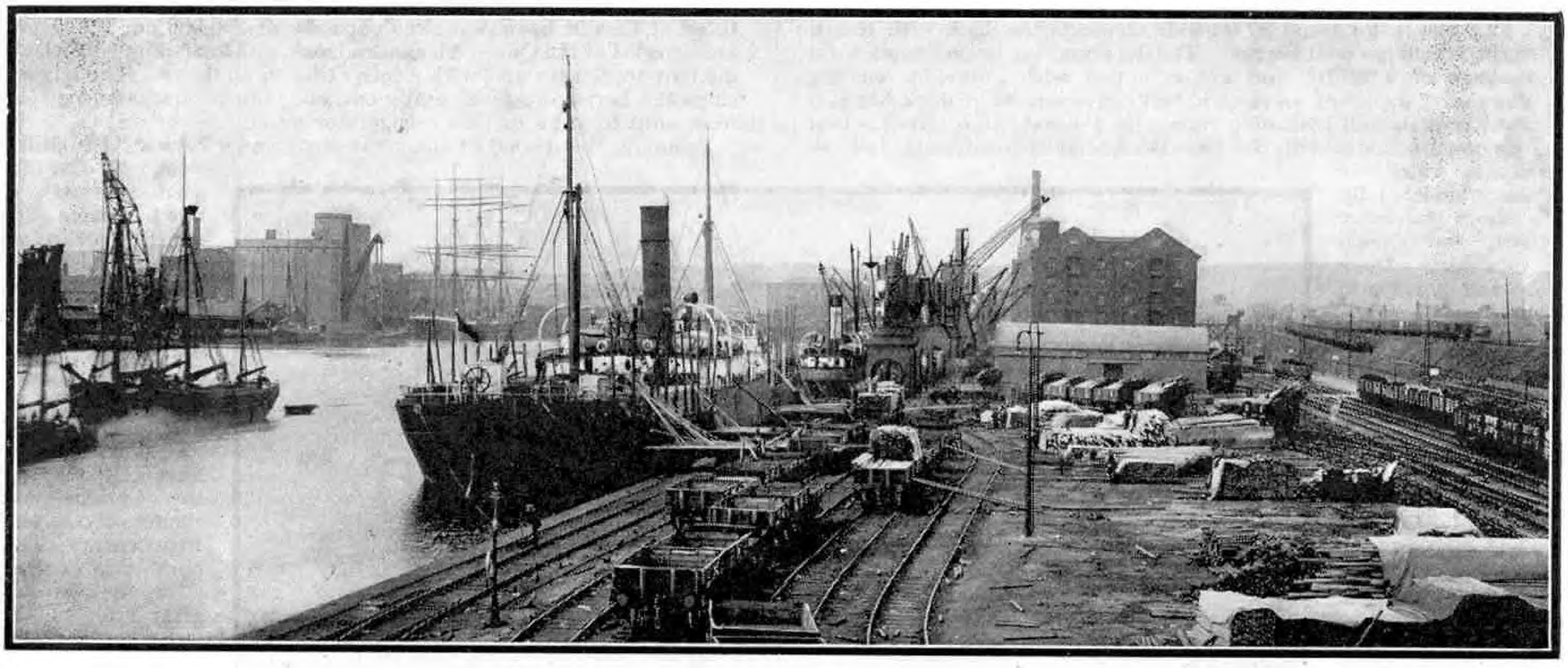
Swansea, the second of the great ports under review, is 46 miles west of Cardiff, and therefore much nearer the mouth of the Channel. The original name of the port is believed to have been "Sweynsei," a word traceable to a Dutch pirate named "Sweyne" who is believed to have frequented the place for shelter about the 10th century. The port was called "Sweyne's Inlet," after him, but it was described as "Sweynsei" in 1188 by Giraldus. Subsequently the name was varied in many ways until 1738, when the Corporation, adopting what had become the general pronunciation, spelt it "Swansea" for the first time in their documents.

Towards the end of the 18th century Swansea began to show signs of its importance as a port, and in 1768 the number of ships loaded there was 694 and their total tonnage 30,631. By 1793 the number of ships had increased to 2,028 and the total tonnage to 120,822. The establishment of the copper industry at Swansea gave further impetus to the trade of the port. The smelting of copper brought with it the treatment of allied ores, and in this way Swansea became the metallurgical centre of Great Britain, and later of the world. The development of the British tinplate industry also helped the growth of the port, and is now centred in the Swansea district.

The earliest harbour works on a large scale at Swansea were those of the South Dock Company, begun in 1847 and completed 12 years later. The South Dock is 1,538 ft. long and 360 ft. wide, and has a basin 380 ft. long and 440 ft. wide. The dock and the basin have a total area of 18½ acres, and 6,310 ft. of quayage. The South Dock is now used by the smaller craft frequenting the port.

In time more accommodation for shipping became necessary, and the construction of the Prince of Wales' Dock was begun. This dock was opened in 1881, and subsequently was enlarged to its present dimensions, which are 3,221 ft. long and 500 ft. wide, with a deep water area of 28 acres. It is equipped with 34 cranes, seven coal hoists and a belt conveyor, in addition to warehouse accommodation providing 226,120 sq. ft. of floor space. The dock is largely utilised in connection with various lines of regular sailings to the Continental ports, etc.

The trade of Swansea continued to increase, larger ships were attracted to the port, and in a short time the authorities were again faced with the necessity of providing further accommodation. The construction of the King's Dock was put in hand, and was completed in 1909. It is 4,200 ft. long, 400 ft. wide and 71 acres in extent, and is the largest of the Swansea docks used for general purposes. The dock can cope with the largest types of freight ships, and its equipment includes 65 hydraulic and electric cranes—the most powerful of which is capable of lifting 70 tons—and seven coal hoists having lifts of 60 ft. from quay level and



capable of unloading 20-ton wagons.

The fourth dock, known as the Queen's Dock, was opened in 1920. It is slightly smaller than the King's Dock, being 3,200 ft. long and 350 ft. wide, with 3,650 ft. of quayage. The western side of the dock is used for oil traffic, and the facilities provided enable a 10,000-ton tanker to discharge her full cargo in 12 hrs., and a tanker of similar size to load the refined product in 20 hrs.

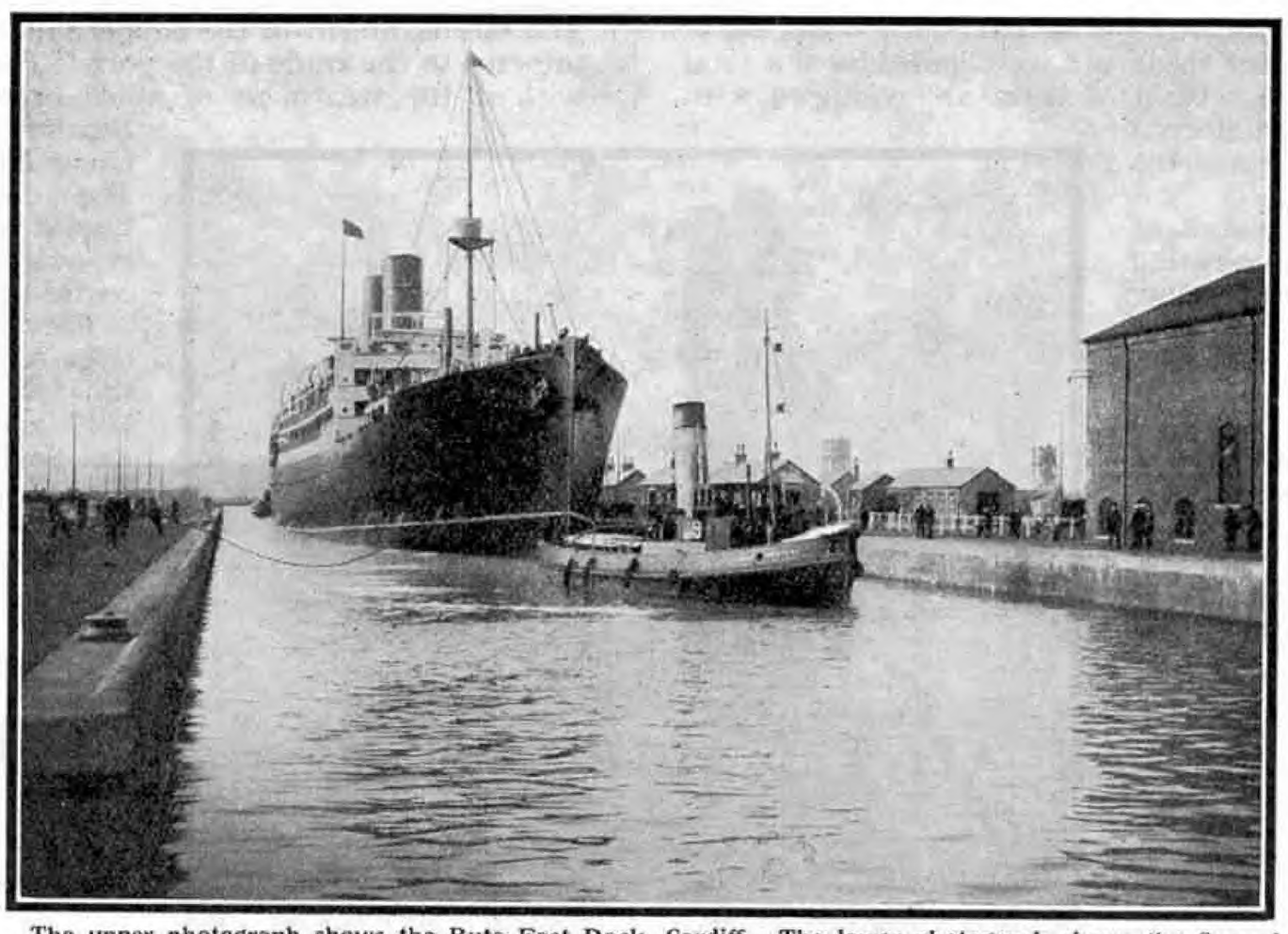
In common with Cardiff and the other South Wales ports, Swansea exports huge quantities of coal, and during 1933 no less than 3,525,825 tons of coal and coke were shipped, roughly 80 per cent. of the total exports of the port. Next in point of volume comes the tin-plate industry, with 410,911 tons shipped from Swansea during 1933. Other substantial exports are oil, patent fuel, iron and steel rails, and ironwork. An oil bunkering jetty in the entrance channel to the King's Dock enables ships to bunker with fuel oil without entering the docks.

The import trade of Swansea during 1933 totalled 992,472 tons, and almost half of this was in respect of crude oil. An immense oil-refining industry has been established at the port by the Anglo-Persian Oil Company and their allies, the National Oil Refineries. Tankers bring the crude oil from Abadan, in Persia, to Queen's Dock, where it is discharged into a series of storage tanks adjoining the dock, and is pumped from these to the refineries at Llandarcy, about four miles east of Swansea. Other commodities of which many thousands of tons are brought to the port annually are pitwood and mining timber, iron and steel, copper and other ores, grain and flour.

The port is also an important centre of the fishing industry, and this branch of its trade dates back to 1901, when a fleet of deep-sea steam trawlers was established. The fleet now totals about 40 vessels, and about 15,000 tons of fish is landed annually. Extensive fish wharves and a large fish market have been provided at the South Dock Basin, and a large ice factory also has been installed, chiefly in connection with this industry, with an average daily production of 60 tons of ice.

Newport, the third port to be dealt with, owes its rapid progress to its situation close to the eastern end of the South Wales coalfield, and at the estuary of a deep and spacious tidal river, the Usk, flowing into the Bristol Channel. The earliest dock at Newport was opened in 1832 and was only 4½ acres in extent, but in 1858 it was enlarged to 12 acres. It is known as the Town Dock, and is now disused.

The trade of the port increased, and Alexandra North Dock, of about 30 acres, was opened in 1875 by the Alexandra (Newport) Dock Company. This company had been formed about 10 years before, and the improved facilities that the North Dock provided led to keen competition between them and the original Newport Dock Company, who owned the Town Dock. An effort to get as much traffic as possible into the Town Dock resulted one day in 1882 in two vessels becoming jammed in the lock entrance, so that the gates could not be shut and the water ebbed away with the tide. This disaster proved the undoing of the old company, and within a year they sold their dock to the Alexandra (Newport and South Wales) Docks and Railway Company.



The upper photograph shows the Bute East Dock, Cardiff. The lower photograph shows the Cunard liner "Ascania" being escorted through the South Lock, Newport. This lock is 1,000 ft. long and 100 ft. wide, and is one of the largest sea-locks in the world.

In time a third dock became necessary, and the first portion of the Alexandra South Dock was opened in 1893, a new entrance from the River Usk being provided by means of a lock 503½ ft. long and 72 ft. wide. The second and larger portion of the dock was brought into use at intervals, 48 acres of it being opened in 1907 and the remaining 27 acres in July 1914. The complete dock is in the shape of the letter "L," and the larger arm is 4,000 ft. long and 1,000 ft. wide. The Alexandra North and South docks are connected by a junction 57½ ft. wide, and thus form one sheet of water of about 125 acres.

The South Dock is entered direct from the Channel through the great sea-lock opened by Prince Arthur of Connaught on 14th July, 1914. This lock is 1,000 ft. long and 100 ft. wide, and is one of the largest sea-locks in the world. In addition to the gates at each end there is a pair of intermediate gates to enable the lock to be divided into two sections, the section nearer the Channel being 400 ft. long and the one nearer the dock 600 ft. long. When full the lock contains about 30,000,000 gallons of water. An impression of the size of the South Lock, as it is called, is given by one of the accompanying illustrations showing the Cunarder "*Ascania*" proceeding through it to sea. This ship is 519 ft. long, 65 ft. wide, and of 14,000 gross tons.

The dock equipment at Newport includes 21 (*Continued on page 385*)

The Story of Bowls

A Game that Once was Played by Kings

BOWLS is the oldest of all British outdoor pastimes, with the exception of archery. It dates back to the 13th century, and various manuscripts of that period contain drawings showing the game in progress. Although at that time the game existed in a somewhat rudimentary form, it became so popular that it seemed likely to form a greater attraction than the practice of archery. The possibility of this alarmed Parliament, as the bow then played an important part in warfare; and in 1366 a Statute was signed by Edward III declaring that "the throwing of stones," and certain other games, were "alike dishonourable, useless and unprofitable." The disapproval of King and Parliament had no effect in diminishing the popularity of bowls, however, and archery became increasingly neglected. In 1388 Parliament prohibited servants, artificers and labourers from playing certain games, including "the casting of the stone," and in 1409–10 a Statute signed by Henry IV declared that "he who playeth at unlawful games shall be six days imprisoned."

Until the middle of the 15th century the game was played only on bowling greens, but in 1455 the first bowling alley was opened in London, and was soon followed by others. Two forms of bowling alley came into use. One form enabled the game to be played under cover, and consisted simply of a floor of wood or other material prepared for the purpose. The other form was really a miniature outdoor green consisting of a narrow lawn laid down between high hedges of yew and other trees in the grounds of large houses.



A reproduction of the painting by Seymour Lucas of Drake playing bowls at Plymouth Hoe when news of the approach of the Spanish Armada was received.

From time to time the illegality of bowls was restated by Parliament, and as the game continued to flourish the law was made more and more strict. In 1477 the penalty of six days' imprisonment for playing bowls was increased to two years' imprisonment and a fine of £10; and anybody found allowing a game to be played "in his Gardens, or other Place, shall be three years imprisoned and forfeit £20." During the 16th century other prohibitive laws were passed, and one of these, dated 1511-12 and signed by Henry VIII, is of particular interest, as in it the word "bowls" occurs for the first time.

Play on the greens was possible only in summer, and at other seasons the game was restricted to the alleys. Many bowling greens and alleys were situated close to taverns and inns, and in time they became a favourite haunt of gamblers, who found the game a useful source of betting. This misuse of the game brought it into even greater official disfavour, and an Act of 1541-2 prohibited anybody from maintaining for his livelihood or profit "any house, alley or place of bowling," and also authorised magistrates to search suspected premises and make arrests.

Stow, a 16th century writer who is chiefly remembered for his "*Survey of London*," records that the gardens of old Northumberland House, in Coleman Street, "were made into bowling alleys, and other parts into dining houses, common to all comers for their money, there to bowl and hazard; but now, of late, so many bowling alleys and other houses for unlawful gaming have been raised in other parts of the city and suburbs, that this, their ancient and only patron of misrule, is left and forsaken of her gamesters."

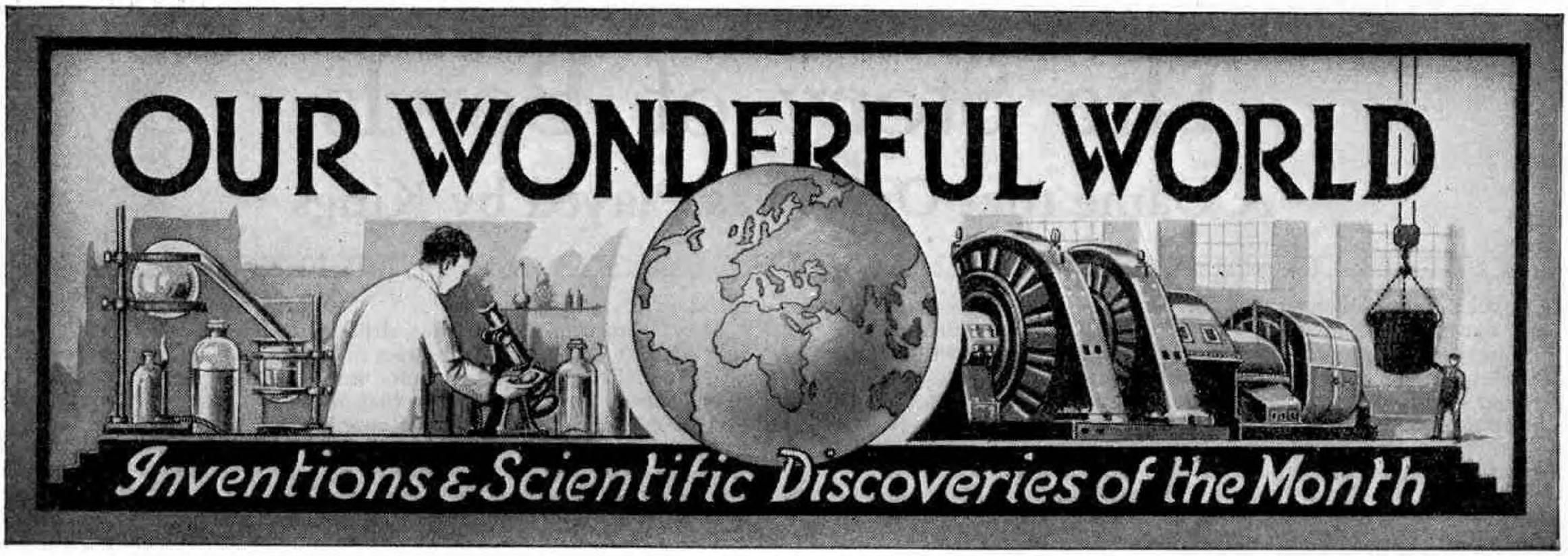
It is interesting to note that although it was illegal for anybody to "play at any bowls or bowles in open place out of his garden or orchard," artificers, servants and the like were allowed to play "during Christmas time in their masters' house and presence"; and people with an income of over £100 a year could obtain a licence permitting them to play privately on their own premises. This latter facility was withdrawn in 1555, probably on religious grounds, as it was thought that it provided an excuse for unlawful assemblies and conspiracies.

The general disregard of the legislation against bowls extended even to Royalty. Henry VIII broke his own laws in playing bowls at Hampton Court Palace, and in ordering bowling alleys to be included in additions he had made to Whitehall. Charles I was another bowls enthusiast, and he often played on the fine bowling green at Barking Hall, Essex, the residence of a wealthy merchant named Richard Shute. Everyone is familiar with the story of the game of bowls played by Sir Francis Drake, Lord Charles Howard, and other Naval officers on Plymouth Hoe, at the time when the Spanish Armada was expected. According to this story, the accuracy of which there is no reason to doubt, a messenger rushed up while the game was in progress with the news that the Armada had been sighted off the Lizard. Drake calmly waved the messenger aside, saying that there was plenty of time to finish the game and beat the enemy afterwards.

Pepys, the famous diarist, played bowls, and Shakespeare not only took part in the game with enthusiasm, but also referred to it on several occasions in his plays. Mention may be made also of John Metcalfe, the famous 18th-century road-maker and bridge-builder. Metcalfe was blind from the age of six, and among the many stories told to illustrate the remarkable manner in which he overcame this handicap is one concerning his skill as a bowler. His hearing was exceptionally acute, and when he played bowls he stationed a friend at the jack and another about the middle of the green. During play he addressed each of them in turn, and gauged the direction and distance by the sound of their voices when they replied. We are told that in this manner Metcalfe contrived to play quite a good game.

The playing of bowls was not made legal until 1845, when the portions of the Act of 1541 referring to the game were repealed.

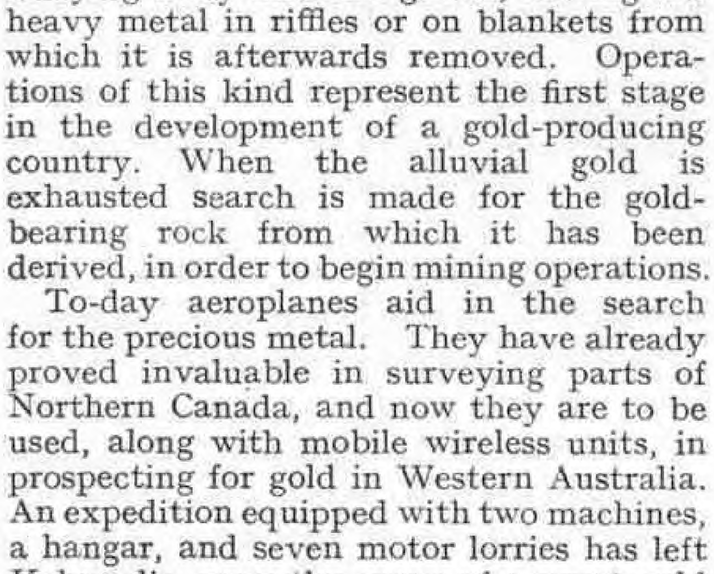
Two types of bowls, known as the crown green game and the rink game respectively, are played in this country. The basic principles of both are the same, but the games differ in certain respects. The most prominent difference is that the crown green game is played on a green that slopes up gradually from the edges to the centre, or crown, whereas the rink game is played on a flat green. In both games the object is to place as many bowls as possible nearer to the "jack," a smaller bowl that is played first, than those of the opponent. The bowls are biased, that is they are made slightly less round, and proportionately heavier, at one side than the other, and this causes them to take a slightly curved path when played. In the crown green game the jack also is biased.



The illustrations on this page are of special interest in that they show contrasting mining scenes in the Old and New Worlds. Tin was mined in Cornwall considerably more than 2,000 years ago when civilisation centred on the eastern end of the Mediterranean Sea, and a visit to Cornwall for the purpose of bringing back highly prized metals was a far greater undertaking than a voyage to British Columbia or any other gold-producing country in the world is to-day.

A further contrast is provided by the manner in which the metals are being worked. Cornish tin is extracted by burrowing deep in the earth, and bringing the tin-bearing rock to the surface to be crushed and treated for the recovery of the metal. The miners shown at work in our British Columbian scene are dealing with alluvial deposits containing gold, and the water rushing down their sluice is carrying away dirt and gravel, leaving the heavy metal in riffles or on blankets from which it is afterwards removed. Operations of this kind represent the first stage in the development of a gold-producing country. When the alluvial gold is exhausted search is made for the gold-bearing rock from which it has been derived, in order to begin mining operations.

To-day aeroplanes aid in the search for the precious metal. They have already proved invaluable in surveying parts of Northern Canada, and now they are to be used, along with mobile wireless units, in prospecting for gold in Western Australia. An expedition equipped with two machines, a hangar, and seven motor lorries has left Kalgoorlie, once the scene of a great gold rush, on a two-year survey of an immense area of that State. Communication between the exploring aeroplanes and headquarters will be maintained continuously by means of wireless, and it is hoped that the geologists of the party will be successful in finding rock formations indicating the presence of gold.



The Land of Pagodas

On the opposite page are typical scenes in Burma. This wonderful country is always associated in our minds with pagodas, and the top illustration shows one of these structures in Mandalay. In the bottom picture an elephant is seen piling teak logs from a Burmese forest. These creatures display amazing intelligence as well as skill in this work.

Burma is famous for its teak forests. The tree grows very fast in the tropical climate, often attaining a height of 10 ft. in two years and 60 ft. in 15 years. The wood is golden-yellow, changing to a darker tint on seasoning, and is of extraordinary durability. In India and Burma teak beams in a good state of preservation are often found in buildings several centuries old. For instance, in 1811 two American travellers found pieces of well-preserved teak in the wall of a palace built by a Persian king near Bagdad more than 1,200 years previously; while in some of the temple caves in India pieces of the wood in good preservation have been found that must be more than 2,000 years old.

Teak wood contains an aromatic oil that gives it a pleasant fragrance, and possibly the presence of the oil accounts for its remarkable durability. It is probably the most valuable of all woods, as besides being very durable it is not subject to warping and is attractive in appearance.

Wonders of Bird Migration

The bird that travels farthest in its annual journeys, and therefore must be the most-travelled bird in the world, seems to be the Arctic tern, a white-feathered bird with a black cap and a forked tail. In the Arctic summer it builds its nest on the islands to the north of America, as near the Pole as possible, and on the approach of winter flies southward until it reaches the Antarctic continent. It spends the southern summer there before returning north, and thus travels 22,000 miles every year. For eight months of the year it lives in daylight, for it times its journeys to enable it to visit each end of the Earth in turn while the Sun is shining there day and night.



How did the tern learn that the coming of darkness and winter in the far north is the time when the midnight Sun will appear in Antarctic regions? At present a complete answer to such a question is not possible, but I think few will agree with a recent attempt to explain the tern's movements, and those of migratory birds generally, on the ground that birds have no real intelligence, and are simply the creatures of the wind, compelled by the prevailing air currents to fly in definite directions at certain seasons of the year. It is quite likely that the movements of flying birds may depend to a certain extent on the direction of the wind. If this is the true cause of migration, however, it is difficult to understand why the green woodpecker stays at home throughout the winter, for it is as good a flier as many birds that migrate regularly; or why the gull, the teal and other birds do not migrate with the regularity of the swallow.

The Stork Routes to Winter Quarters

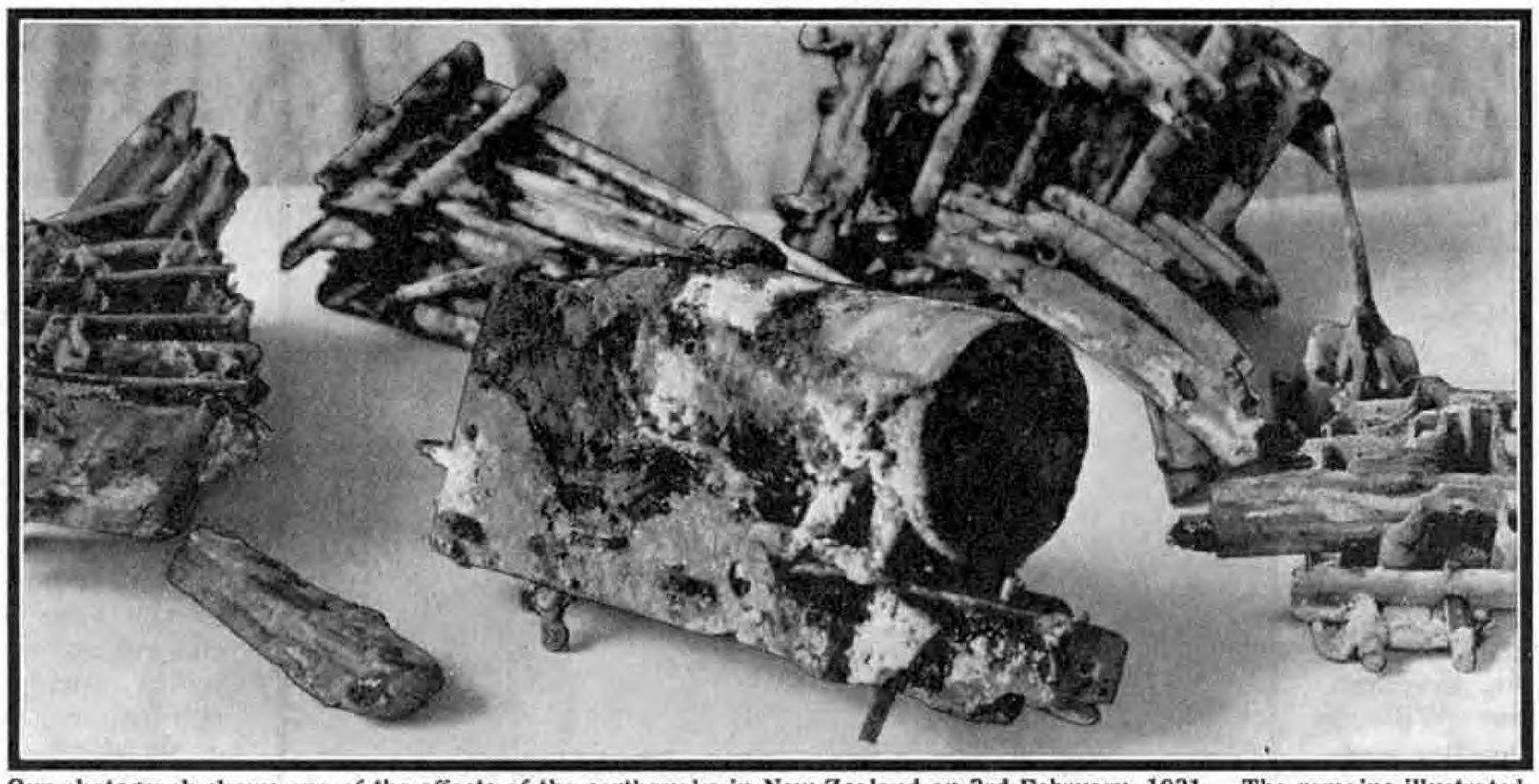
Birds probably follow regular routes during their migration, and it is hoped that an interesting experiment recently set on foot in Germany will throw light on this problem. The subject of this experiment is the stork, the bird that is famous in the legends of central Europe, where it has been a favourite for hundreds of years, and is still remembered with regret in countries where it no longer finds a home.

In their southward flight on the approach of winter storks seem to follow one of two routes. Birds from East Prussia, and from Eastern Europe generally, reach their


A BEAUTIFUL PAGODA AT MANDALAY.

winter homes in the southern hemisphere by flying across Asia Minor and Palestine; while those from Western Germany pass across France and make their way into Northern Africa across the Straits of Gibraltar. As a great experiment young storks bred in East Prussia have been taken to Essen, in West Germany, where they were released, after being ringed, in order to find if any hereditary instinct will impel them to choose the eastern route to Africa, or whether they will follow the western route favoured by birds that have nested in the Essen district.

It is curious to find that when the East Prussian storks were released in the strange surroundings of Essen, they spent a long time walking about in the meadows catching frogs, and did not take to the air until late in the evening. Then they formed two distinct groups, each of which circled round for some time before flying away. Later the birds returned, and it was not until a few days afterwards that they began their southward flight. Two of them have already been traced to the valley of the Loire, in France, and news of the capture of others taking part in the experiment will be awaited with keen interest.


Our photograph shows one of the effects of the earthquake in New Zealand on 3rd February, 1931. The remains illustrated are those of a Hornby No. 1 Special Train Set found 11 months later in the ruins of Cottrell's Novelty Depôt at Napier. In the left foreground is a bundle of Meccano Strips fused into a solid mass.

Finding the Centre of the Universe

The Royal Astronomical Society recently awarded its Gold Medal to Dr. Harlow Shapley, Director of the Harvard College Observatory in the United States. There is an interesting story behind this award, for Dr. Shapley is the astronomer who discovered the exact position of our Earth in the Universe.

This discovery was really a romance of careful measurement, and its starting point was a study 20 years ago of certain stars that had long been known to show regular changes in brightness. These fluctuating stars are known as the Cepheid variables. They are to be seen at many different points in the sky, and it was found that the time they take to complete the cycle of changes from one period of great brilliance to the next depends on their real luminosity or candle power.

Dr. Shapley found that many of the Cepheid variables change in brightness at the same rate, and realised that these must have the same real luminosity. If one of two stars of this kind seems brighter than the other, therefore, it must be nearer to us, and a comparison of the apparent luminosity of the two bodies will give their relative distances from the Earth. Fortunately the distances of several of the Cepheid variables were already known, and as a result of Dr. Shapley's work we now know how far away the more important of them are. Dr. Shapley was able to use this knowledge as a measuring rod for the Universe, and when its extent and shape had been calculated, it was found that the Earth does not occupy the position near the centre formerly ascribed to it, but is 270,000 billion miles away.

The results of the gropings of astronomers into the shape and size of the Universe have been startling. It is generally accepted that the stars, separated by distances that are too great to be appreciated by ordinary minds, form an immense disc in space. This disc seems to be expanding, for the great nebulae and other masses of which it is composed appear to be rushing away from each other and from the centre of the Universe at enormous speeds. The nebula most recently scrutinised was found to be moving at the amazing speed of 12,300 miles a second; and so rapidly are these bodies travelling outward that the Universe apparently doubles in size every 1,400,000,000 years!

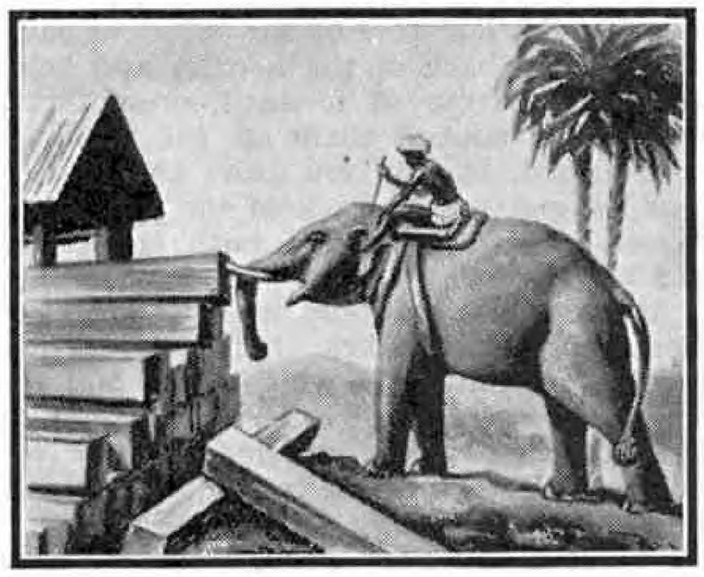
If this view is correct, the Universe is like a clock spring that has been wound up and is now becoming unwound. It cannot be a very long time, astronomically speaking, since the starry world began this movement, for its present size does not allow for many doublings, and the measurement suggests that it is about 10,000,000,000 years old. To ordinary people this may seem a respectable and even venerable age, but it does not satisfy astronomers, who do not think it enough for many other changes that undoubtedly have taken place during its history.

A New Kind of Water

Bodies too small to be seen with the aid of the most powerful microscopes may be as interesting to scientists as those weighing millions of tons. Among the tiny particles that achieve this distinction are the atom, and its even smaller constituents the proton and the electron, and we are constantly being surprised by astonishing discoveries about them. The most recent of these discoveries is exceptionally interesting, for it has revealed the fact that hydrogen, the well-known light gas that for more than a century has been regarded as the standard of measurement in the chemical world, is not quite as simple as we have thought. We now know that about one in every 4,000 atoms of this gas is twice as heavy as each of the remaining 3,999. Thus there are two hydrogens instead of one.

It is interesting to read how the new kind of hydrogen was brought to light. Every owner of a Kemex Outfit knows that water can be made by burning hydrogen in oxygen, and thus is hydrogen oxide. This liquid therefore should include a very small proportion of molecules containing the heavy hydrogen atom. This actually is the case, and these molecules are less easily split up by means of the electric currents that those of ordinary water. Therefore, when water is decomposed by passing an electric current through it, the proportion containing heavy hydrogen steadily rises; and when 30 litres of water were treated in this manner until only a cubic centimetre of liquid remained, the residue was found to be 10 per cent. heavier than ordinary water, and to have different freezing and boiling points. The product of prolonged electrolysis is in fact almost pure heavy water. Thus the effect of passing an electric current through water is to separate the two kinds of hydrogen, for light hydrogen is liberated first, and the decomposition of the heavy water will give heavy hydrogen.

Discoveries of this kind would have been a great shock to old-fashioned scientists, who believed that the atoms of any one element were alike in every respect. About 20 years ago it was discovered that most elements consist of mixtures of several kinds of atoms differing from each other in weight, but chemically inseparable; and now for the first time different kinds of atoms of one and the same element have actually been separated from each other.



How The Knitting Industry Developed

The "Maratti" High-Speed Machine

KNITTING is one of the more modern of the textile processes. Even hand knitting is not mentioned earlier than the 15th century, when it is supposed to have originated in Scotland and to have spread to England. An Act of Parliament dated 1488 informs us that the price of knitted woollen caps was then two shillings and eightpence. As the art of knitting developed more difficult work was attempted, and we learn from an Act of Edward VI, dated 1553, that "knitte hose, knitte peticotes, knitte gloves and knitte slieves" were being made at that time. Another Act, dated 10 years later, contains a reference to the trade of hosiers.

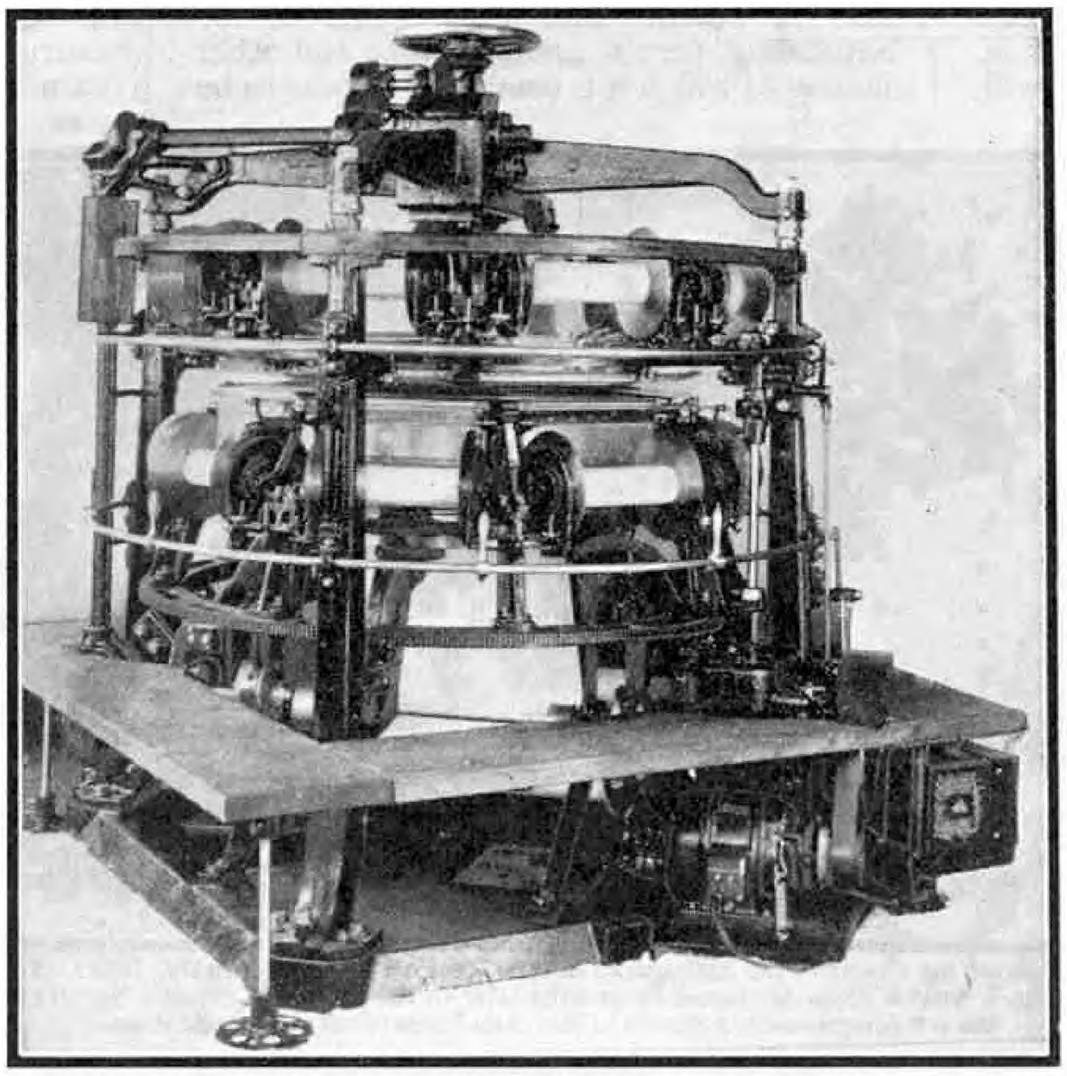
In hand knitting only one thread or strand of yarn is used, and the fabric is made by repeatedly interlooping the thread or yarn by means of needles or wires. The fabric produced in this simple manner is very elastic and can be extended in any direction; and on this account a knitted garment gives an easy fitting. A great variety of fancy stitches and loops can be produced by hand knitting, and the needles used vary in length, and thickness or gauge, according to the class of knitting undertaken. The needles are made of steel, bone, ivory or wood, and usually those used for flat, selvedged work are headed to prevent the loops of thread from slipping off them. Needles pointed at both ends are used, three or four at the same time, for knitting round-shaped articles such as stockings. An expert hand-knitter can knit 100 loops per minute.

The first mechanical knitter was a stocking frame invented in 1589 by the Rev. William Lee, of Calverton, Nottinghamshire. It was the result of seven years' patient experiment, and was a masterpiece of mechanical ingenuity. The stocking frame was a great improvement upon hand-knitting, and could knit nearly 1,000 loops per minute, this speed being attained by providing a needle for each loop, so that all the loops in the row were formed at the same time. The needles were turned up at one end to form a hook, or "beard" as it is called, and the thread was laid by hand across the row of needles, passing within the beards. Thin metal plates called "jack sinkers" then descended between each pair of needles, bearing the thread downward, so that when they rose the thread was left hanging in a series of loops. Next a horizontal bar called the presser bar descended across the beards and closed them by pressing their pointed tips into grooves in the bodies of the needles. The loops of the last row of the fabric already knitted by the frame were at the back of the needles and held by the sinkers, which at this stage moved forward, drew these loops over the closed hooks, and slipped them off the needles. The presser bar was then raised, the sinkers drew the new row of loops from the bearded end to the back of the needles, and the whole series of movements was repeated until the required quantity of fabric had been knitted.

At first Lee was only able to produce square or rectangular pieces of knitted fabric, but after further experiment he found that he could alter the width of the material at will by periodically omitting loops at the ends of the rows to narrow the fabric, or by adding extra loops to increase the width. Lee endeavoured to patent his invention, but failed, and he then took it to France where he settled successfully at Rouen.

The seed had been sown, however, and gradually the stocking frame came into extensive use. It was adopted in Leicester in 1640, and 20 years later at least 100 of the machines were in use there. London appears to have been the knitting centre about that time, and in 1664 had more than 400 stocking frames in operation. By this time the value of the invention had been realised also abroad, and many machines were exported in spite of Government and private efforts to prevent this traffic. In 1696 an Act of Parliament was passed imposing a fine of £40 and the forfeit of the machines upon anyone found exporting stocking frames.

The increased adoption of the stocking frame attracted the attention of various inventors, who improved it in many minor respects, but its fundamental principles remained unchanged. One of the accompanying illustrations is of a hand knitting machine, made about 1770, that is similar to the original frame invented by Lee. It has a horizontal row of needles with beards turned upward, a presser bar above them, and a steel sinker to each pair of needles. In this machine alternate sinkers are formed into two sets known respectively as "jack" and "lead" sinkers. The "jack" sinkers, under force of the presser bar, carry the thread down and form it into deep loops. The "lead" sinkers then descend to half the depth of the "jacks," which are then raised to a corresponding extent so that the loops are of uniform depth. The presser bar is drawn downward by means of the centre one of three treadles at the base of the machine, and the return of this bar is caused by a spring. The working of the other two treadles actuates a flywheel from which a cord connects with the jack sinkers, and the lead sinkers are depressed simultaneously by two plates at the sides of the machine.



Maratti circular warp knitting machine, the fastest warp knitter in the world. Photograph courtesy Maratti High Speed Circular Knitting Machines Ltd.

In 1858 Jedediah Strutt, originally a farmer, adapted the stocking frame for knitting fabrics of a ribbed pattern. Strutt, and his brother-in-law Woollett, who was a hosier, patented the improved machine, and began the manufacture of ribbed knitted fabrics at Derby, where they built up a prosperous business.

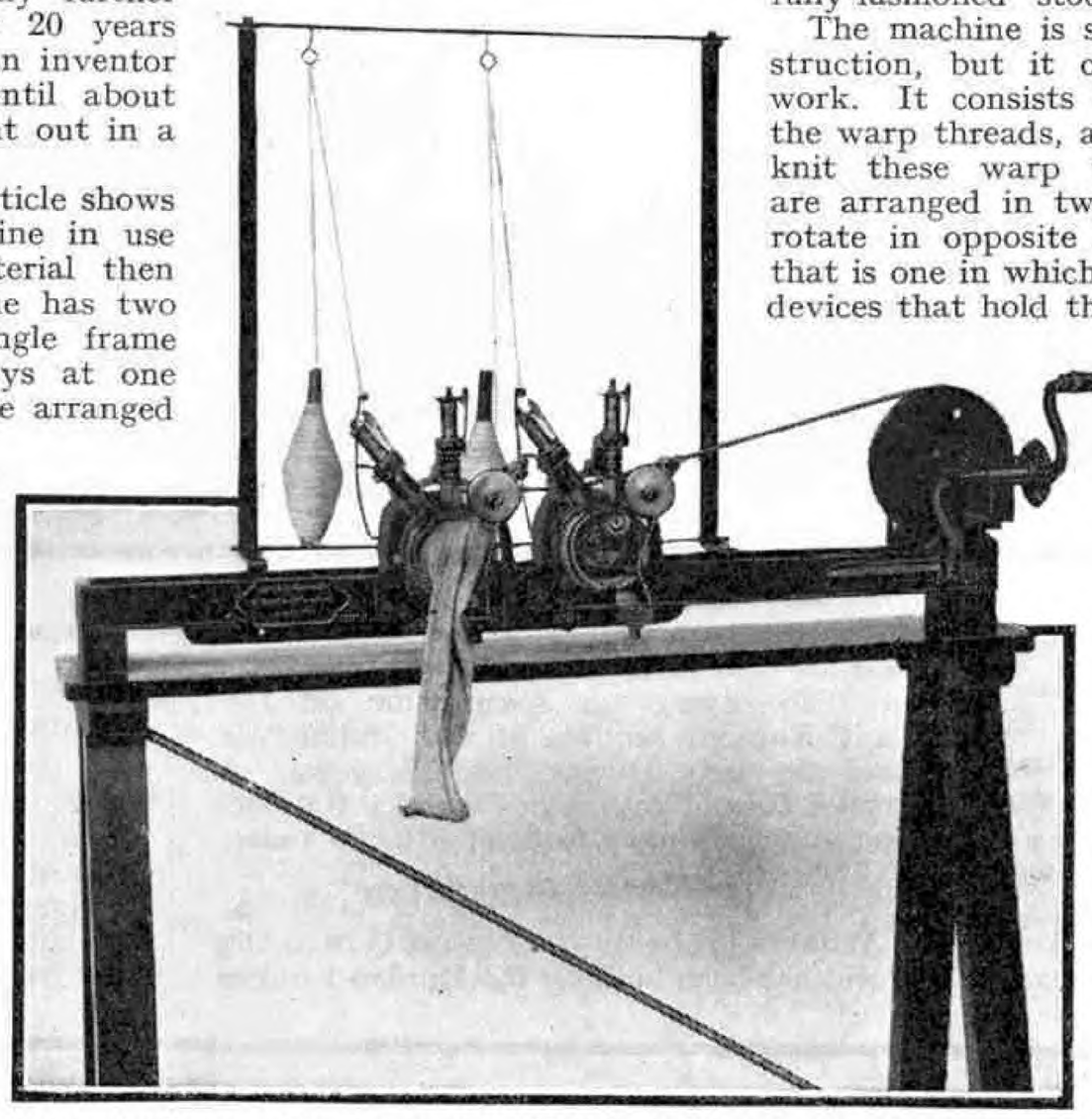
During the first half of the 19th century many other types of machines for knitting flat fabric were invented in the Midlands, and in the neighbourhood of Nottingham, Derby and Leicester. Some of these machines were "warp" knitters, that is, instead of using a single or "weft" thread, and making thousands of loops per minute on the principle of Lee's stocking frame, they employed thousands of threads and made one or two loops in each per minute, a method that reduces the strain to which the thread is subjected. These machines included the warp loom, the multiple head rotating knitting frame, the "Milanese" warp loom, the "Cotton" machine and the "Paget" machine.

In 1828 steam power was used to operate a stocking frame, and from that time power-driven knitting machines gradually superseded the hand-worked machines.

The knitting machines so far described produced only flat fabric, and the first knitting machine capable of producing cylindrical work was invented about 1800 by a Frenchman named Leroy. It attracted the attention of Marc Isambard Brunel, the famous engineer, and in 1816 he patented an improved version of the machine. In this machine the needles were fixed on the frame of a rotating wheel, and the various operations of looping the thread, closing the beard, etc., were effected by a series of arms or wheels that acted on the circumference of the ring of needles.

Several sets of arms and wheels could be at work simultaneously round a ring large enough to accommodate them, and therefore such a machine was capable of very high speed knitting. Brunel does not seem to have taken any further interest in the invention. About 20 years later it was improved by a Belgian inventor named Jouvé, but it was not until about 1845 that the machine was brought out in a form suitable for practical use.

One of the illustrations to this article shows a form of circular knitting machine in use about 1897 for knitting the material then made into stockings. The machine has two knitting heads mounted on a single frame and driven by bands from pulleys at one end. The needles in each head are arranged horizontally in a vertical ring with their beards turned outward, and as the ring revolves the needles act as wheel teeth and engage with the teeth of three pinions that turn freely on inclined axes secured to the main frame. The first of the pinions forms the thread into loops, and the second ensures that these loops are of uniform depth. A fixed roller then closes the beards, and the third pinion pushes the loops on the back of the needles over the beards, in this manner virtually drawing a new loop through each loop of the preceding row. A stationary circular wedge within the ring of needles forces the work backward along the needles, where it is kept taut by the horizontal pull of a weight cord.

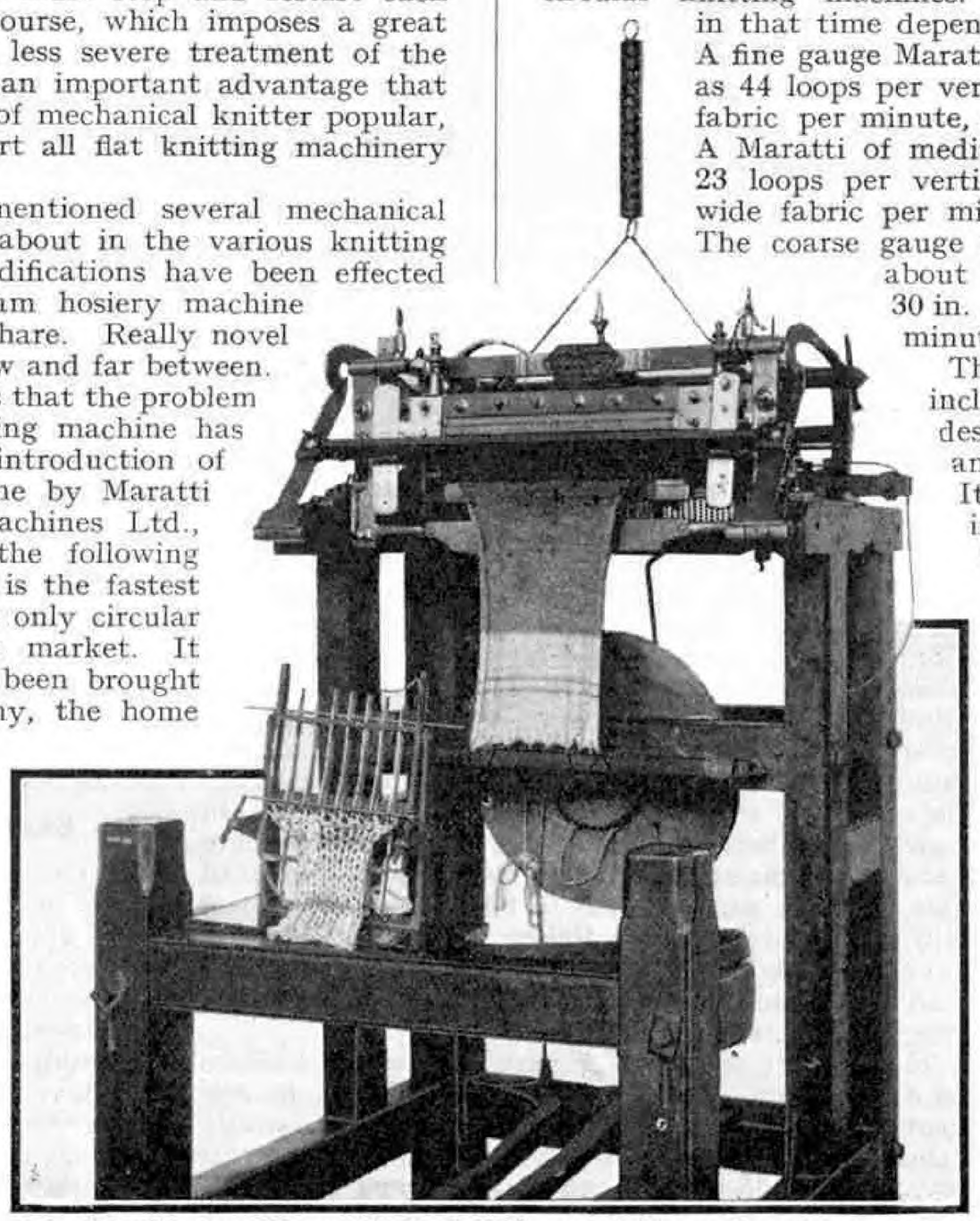


Circular knitting machine in use about 1897 for knitting the material then made into stockings. The photographs on this page are reproduced by courtesy of the Board of Education.

In a circular knitting machine the motion is uninterruptedly in one direction, whereas in a flat knitter the motion is of a to-and-fro character, as the machine must stop and restart each time it comes to the end of its course, which imposes a great strain on the thread. The much less severe treatment of the thread in the circular machine is an important advantage that has done much to make this type of mechanical knitter popular, and has led to attempts to convert all flat knitting machinery to circular motion.

Since the inventions already mentioned several mechanical improvements have been brought about in the various knitting machines, and many beautiful modifications have been effected in which Leicester and Nottingham hosiery machine builders have had a considerable share. Really novel conceptions, however, have been few and far between.

It is only within the last 10 years that the problem of a practical circular warp knitting machine has been successfully solved by the introduction of the "Maratti" high speed machine by Maratti High Speed Circular Knitting Machines Ltd., to whom we are indebted for the following details. This remarkable machine is the fastest warp knitter in the world, and the only circular warp knitter at present on the market. It is a French invention, but it has been brought to commercial perfection in Saxony, the home of the German warp knitting industry, with the aid of British capital and a good deal of British technical co-operation. It is an extremely interesting machine, and works at speeds that until recently were considered quite out of the question. The "Maratti" machine produces commercially a greater range of fabrics than any other mechanical knitter, including material for all classes up to the finest underwear, for pullovers, bathing suits, riding breeches, all classes of outer wear, etc.



A hand-knitting machine made about 1770, and similar to the original stocking frame invented in 1589 by the Rev. William Lee.

Many machine-knitted fabrics can be unravelled, and consequently they "ladder." The fabric made on "Maratti" machines is different, however, because two series of threads are always knitted in diagonally opposite directions, which makes unravelling impossible, and gives in practice a ladderproof fabric. All the "Maratti"-produced materials just mentioned are ladderproof, and experiments are proceeding to produce also a non-laddering fully-fashioned stocking.

The machine is simple and straightforward in construction, but it contains some wonderful precision work. It consists of two sets of drums that carry the warp threads, and a circular bank of needles that knit these warp threads into fabric. The drums are arranged in two tiers, one above the other, and rotate in opposite directions. A 26 gauge machine, that is one in which there are 26 needles and 26 bits—devices that hold the needles—per inch, has a total of 2,000 needles and 2,000 bits accurately spaced and fixed around a 77 in. circumference. Other important features are the mechanism for rotating the sets of drums, carrying crown wheels, in opposite directions; the accurately and simply adjustable mechanism for reciprocating the needles and for adjusting them "en bloc" to the size of loop to be knitted; a three-speed gearbox for adjusting the knitting speed to the class and fineness of yarn to be worked, and the mechanism for withdrawing the knitted fabric from the needles and forming it into a roll. Although the machine weighs about 2,000 lb., it requires only 1¼ h.p. to drive it, and this motive power is provided by its own small motor.

The Maratti machine works at a speed of 500 courses or rows of meshes per minute, a rate of production that is astonishing to anybody familiar only with the rate of production of ordinary circular knitting machines. The quantity of fabric knitted in that time depends upon the gauge of the machine. A fine gauge Maratti, producing fabric having as many as 44 loops per vertical inch, knits 7 in. of 56 in. wide fabric per minute, equivalent to 11.57 yards per hour. A Maratti of medium gauge, producing fabric having 23 loops per vertical inch, can knit 15 in. of 56 in. wide fabric per minute, equal to 25 yards per hour. The coarse gauge machines, producing fabric having about 10 loops per vertical inch, knit 30 in. of fabric, about 80 in. wide, per minute, or a total of 50 yards per hour.

The latest type of Maratti machine includes many minor improvements designed to increase the efficiency and lengthen the life of the machine. It is equipped with ball bearings; inclined teeth on the gear drive to give silent running; high pressure lubrication to increase the durability of all working parts, and an automatic brake so that the machine can be stopped instantly when necessary. The whole of the control mechanism is contained in the bridge box, and the bridge can be lifted off and replaced in a few minutes. Individually mounted and easily interchangeable needles further simplify operations, and one workman, if well trained, is able to attend to two machines. The Maratti is certainly the most remarkable machine brought out in the knitting industry within the last 20 years.

The development of the knitting industry affords a remarkable example of the enormous changes that can be brought about by the introduction of high-speed mechanism. At the beginning of the 15th century knitting was purely a home industry; to-day it is a highly organised and very important branch of the textile trade.



First British Master Air Pilots

Two of the veteran "air skippers" of Imperial Airways Ltd., Capts. A. L. Walters and F. D. Travers, are the first British commercial airmen to qualify for official certificates as Master Pilots.

The Master Pilots' Certificate was instituted in 1929, but the awards to Capts. Walters and Travers are the first that have been made, the requirements for this certificate being such that only pilots of exceptional flying experience, both by night and day, can hope to obtain one. The qualifications necessary include the holding of a current "B" licence, entitling them to fly for hire or reward, and also a licence authorising the pilot to act as an air navigator. Both these licences must have been in force for at least five years.

The applicant for a Master Pilots' Certificate must also have flown for at least 1,000 hrs. as a pilot of civil aircraft during the five years prior to his application; and in addition a considerable amount of night flying experience is required, including a minimum of 20 night flights above land or sea, each flight to begin and end during the hours of darkness and to last at least an hour. This is a very difficult rule to comply with, as commercial night flights do not usually start and end in darkness.

Capt. Walters began flying in 1918, and before becoming an Imperial Airways pilot in 1924 he had 1,100 hrs. in the air to his credit, 600 with the Royal Air Force, 500 on the Continental air routes, and 25 with the R.A.F. Reserve. At the present time his log books show that he has spent a total of approximately 7,500 hrs. in the air as a pilot, during which he has flown a distance of 750,000 miles.

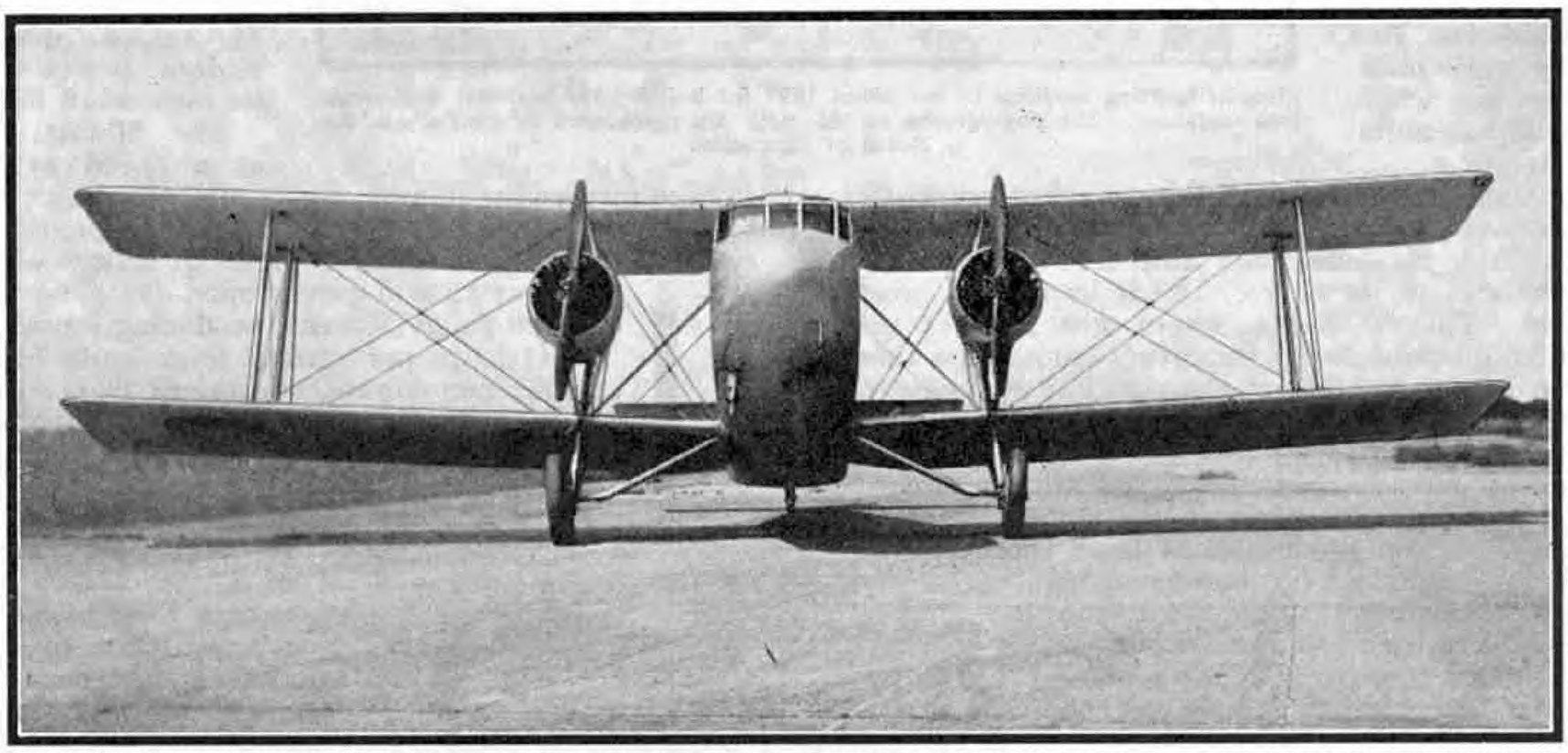
Capt. Travers learned to fly in 1917, and during the War he saw active service in Macedonia, Egypt and South Russia. After the War he became a pilot on the Salonica–Constantinople air mail service, and subsequently operated his own private air taxi service. He joined Imperial Airways in 1926, flying for some time on the Cairo-Karachi section of the Indian air mail service. During his 17 years as a pilot Capt. Travers has spent 6,100 hrs. in the air, flying a total of 610,000 miles.

The World's Biggest Tyre

What is probably the biggest tyre in the world has been built by the Dunlop Rubber Co. Ltd., for use on a huge new four-engined aeroplane that is being built by Short Bros. (Rochester and Bedford) Ltd. This machine is so big that it has had to be built out in the open, the firm having no hangar large enough to accommodate it. The tyre is 5 ft. 10 in. in overall diameter and 22 in. in sectional diameter, the wheel for which it is intended being 26 in. in diameter. The tyre is of the intermediate pressure type, and when it is inflated until the air pressure is 35 lb. per sq. in., it contains about 100 cu. ft. of air that has a weight of about 8 lb. In this condition it would carry a load of 25 tons before flattening out.

It would be a very exhausting task to pump up this tyre with an ordinary bicycle pump, for 13,000 strokes of the pump would be required, and it is estimated that this would take about 3½ hrs. Even when it is pumped up from a high pressure air main, between 15 and 20 minutes are needed to inflate it fully from the flat.

We hope to publish an article on the machine for which the tyre is intended, in an early issue.



Front view of the Blackburn Civil Biplane, an illustrated article describing which is published on page 376 of this issue. Photograph by courtesy of the Blackburn Aeroplane and Motor Co. Ltd.

Entries for the England–Australia Race

A twin-engined two-seater monoplane is now being built in Sydney for entry in the race from England to Australia that is to be flown in October next in connection with the centenary celebrations of the city of Melbourne. The machine has been designed by an Australian engineer and will be an all-Australian effort to carry off the trophy as the pilot will be Australian.

Two aeroplanes have been entered also by the K.L.M., or Royal Dutch Air Lines. It is probable that one of these machines will be the Fokker F.XXXVI, now being built at the works of the Fokker Company. This machine will be a high wing cantilever monoplane of typical Fokker design and construction, but it will be equipped with four engines of the Wright "Cyclone" type, each developing 650 h.p. The designers state that it will be capable of cruising at 142 m.p.h. and of travelling for a distance of about 870 miles without refueling. No information is available concerning the second machine that has been entered by the Dutch Company.

England to Denmark in Five Hours

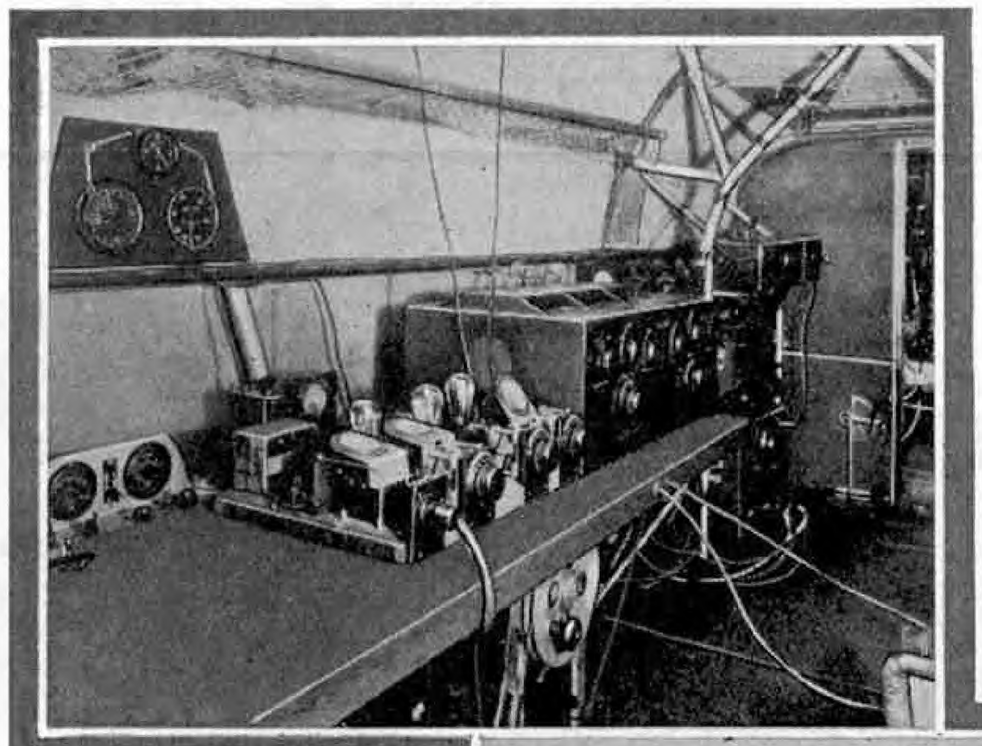
On page 602 of our issue for August 1933 we described the Percival "Gull," one of the most noteworthy aeroplanes produced in this country for some years. An interesting fast flight has recently been performed on a machine of this type by a Swedish private owner, who flew from Gravesend aerodrome to Copenhagen in Denmark in a flying time of 4 hrs. 40 min., little more than an hour longer than is required to travel from London to Liverpool by train. During the course of the flight landings were made at Amsterdam and Travemunde. Bad weather was experienced on part of the journey, and but for this much less time would have been taken. The return flight occupied 5 hrs.

Touring by Air and Ocean Liners

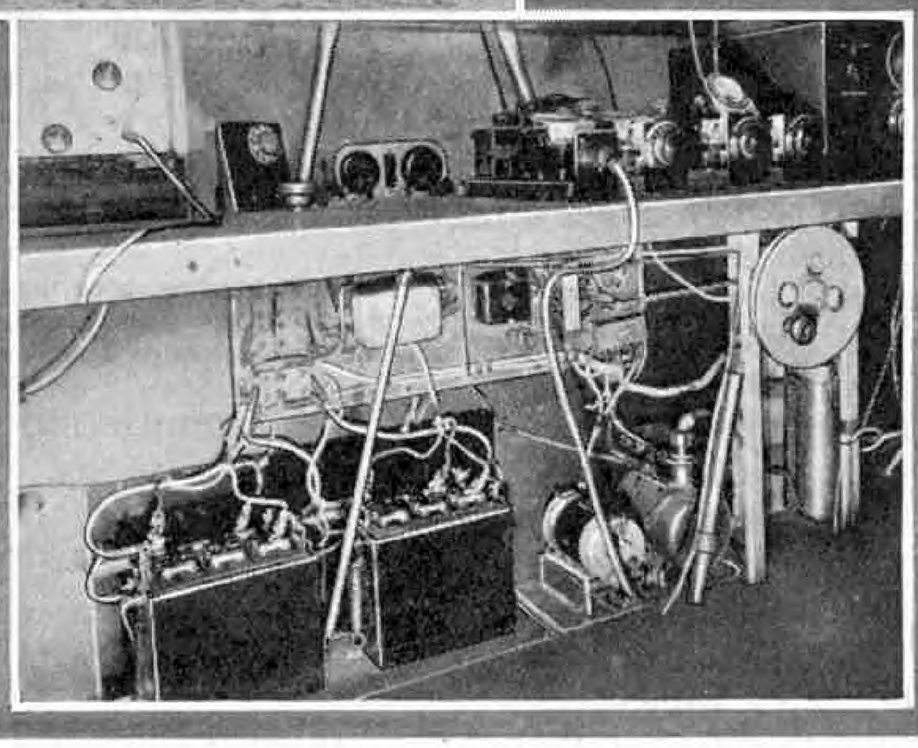
Combined air and sea tours are now provided by a series of cruises by ocean liner, air liner and flying boat, the first of which began in March last, and which are intended to continue throughout the forthcoming summer.

The first tourists under this scheme left New York in the liner *"Rex"* on 3rd March and reached Gibraltar six days later. There they changed to another liner, the *"Duilio,"* which carried them to Dakar and onto Capetown, where they arrived on 22nd March. After several days of sight-seeing, including a visit to the famous diamond mines at Kimberley, the tourists began the air part of the tour by embarking in an Imperial Airways machine for a flight in stages across Africa from south to north. This gave them a wonderful bird's-eye view of the great African continent-hills, mountains and rolling plains, alternating with forests, lakes and rivers. During their passage over the big game country the travellers had opportunity of watching wild life from the air, which is one of the chief fascinations of an aerial voyage over Africa.

After reaching Cairo the party changed from a landplane to one of the big flying boats of the Imperial Airways Mediterranean service, and enjoyed splendid panoramas of coastal and island scenery en route for Athens and Brindisi. After this there was a train journey to Naples, where they caught the liner *"Vulcania"* and returned to New York, which was reached on 18th April. During the tour a distance of more than 13,000 miles was covered, nearly half of which was made in aeroplane and flying boat.







Centre : A United States Army Air Corps aeroplane used as a flying laboratory for the flight testing of radio equipment. Top and bottom : Some of the elaborate apparatus carried in the machine for testing purposes. Official photographs, U.S. Army Air Corps.

Another Russian Stratosphere Flight

A fund to be named after the Soviet airmen who perished when their machine crashed after a flight into the stratosphere, as stated in last month's issue of the *"M.M.,"* is to be opened in Russia, and the proceeds are to be used to finance further exploration of the stratosphere. A stratostat is to be built that will be considerably lighter than either of those already constructed in Russia, and will make use of fabric capable of resisting temperatures as low as minus 70 deg. C. No crew will be carried, all the apparatus being designed to function automatically, including cameras to take photographs of the Earth's surface from various heights, and special instruments to transmit by radio the impulses of cosmic rays. It is hoped that the balloon will reach a height of 24 miles.

The King's Cup Air Race

The race for the King's Cup is to take place this year on Friday and Saturday, 13th and 14th July, and to start and finish on each day at Hatfield Aerodrome, Hatfield, near London, the new aerodrome of the De Havilland Aircraft Co. Ltd. The race will be flown in four rounds, two on the first day and the semi-final and final on the second. There will be eight heats in the first round, and four in the second, the distance in each case being about 250 miles. The third round of 200 miles will be flown in two heats, and the final round will be 100 miles in length.

The race is open to any British subject, but pilots taking part must have flown solo for at least 100 hrs. prior to 1st May, 1934. Any civil aeroplane that has been constructed in the British Empire may be entered. Lord Wakefield of Hythe has presented prizes amounting to £500 that will be distributed in addition to the Cup presented by the King.

Fast British Single-Seater

Mr. E. W. Percival, designer of the Percival "Gull," which was illustrated and described on p. 602 of our issue for August 1933, has now produced a very small and fast single-seater low wing monoplane. It is only 24 ft. in wing span and 18 ft. 3 in. in overall length, and the pilot is accommodated much further back than is usual in British types, the covering for the cockpit being faired in with the rudder. The engine employed is a Napier "Javelin," which develops 165 h.p.

A Notable 4-Engined Air Liner

The fastest and smallest four-engined air liner so far built in any country has recently successfully passed its official flying trials at Martlesham Heath, Suffolk. This machine has a top speed of more than 170 m.p.h. and has been built by the De Havilland Aircraft Company Ltd., for Imperial Airways and "Quantas" Empire Airways, for use on the section of the England-Australia service between Singapore, Port Darwin and Cootamundra, the terminal, in New South Wales. This section is to be opened in the near future.

The new liner is of the biplane type and is driven by four 200 h.p. engines mounted in the leading edge of the lower wing, two on each side of the fuselage. The passenger accommodation consists of a single luxuriously-equipped saloon with seats for 10 people. A specially-designed variable ventilator is provided for each passenger to enable him to control personally the conditions in the cabin in his immediate vicinity.

An enclosed cabin is provided for the navigating crew, which consists of a captain and a first officer. This cabin is arranged in the extreme nose of the fuselage, thus ensuring an unobstructed view, and is equipped with all the latest navigating instruments and a powerful radio transmitting and receiving installation.

The machine is capable of flying on any two of its four engines, thus practically eliminating danger of forced landings. With all engines operating satisfactorily it can attain a height of nearly four miles, and with three engines running it can climb to nearly three miles. It is capable of climbing to 1,200 ft. within one minute of leaving the ground. The chief obstacle in flying to and from Australia is the crossing of the Timor Sea, but the new air liner will be able to complete this 400-mile passage in less than three hours.

Vacancies for R.A.F. Apprentice Clerks

The Air Ministry announce that vacancies exist in the R.A.F. for well-educated boys, in possession of an approved first school certificate, between the ages of 15½ and 17, to enter as apprentice clerks in July next. Entry will be by selection from among applicants with the necessary educational qualifications.

Detailed information can be obtained from the Secretary, Air Ministry (Apprentice Clerks Department), Gwydyr House, Whitehall, London, S.W.1. Successful candidates will be required to complete 12 years' regular air force service after reaching the age of 18.

British Aircraft Developments

XI.—Blackburn Civil Monoplane and Biplane



THE old question as to whether the monoplane or the biplane is the more efficient type of aeroplane still remains unanswered, in spite of prolonged and often heated arguments. The reason is of course that no clear-cut answer can be given, because everything depends on circumstances. For certain purposes the biplane is the ideal machine; for other purposes the monoplane is superior.

Generally speaking, a machine that is required to carry heavy loads at both high and low altitudes, to be able to withstand great stresses and strains while in the air, and to land easily, should be of the biplane type. This is borne out by the fact that nearly all the machines used in the Royal Air Force are biplanes. Monoplanes, on the other hand, are usually more suitable for high-speed flying, as is shown by the fact that in the last few races for the Schneider Trophy monoplanes only were entered.

The above illustration shows the Blackburn Civil Monoplane. For the photographs accompanying this article we are indebted to the Blackburn Aeroplane and Motor Co. Ltd.

Monoplanes may be regarded as more generally suitable than biplanes for the private owner, as a better view can be obtained from the interior. In the case of the high-wing type of monoplane, however, this advantage is somewhat offset by the fact that the machine is rather more difficult to land. When a biplane or a low-wing monoplane is being landed it sets up a " billow " or wave of air between the wing and the ground, and this lightens the landing. In a high-wing monoplane the wing is too far above the ground for this billow to be set up, and consequently this type of machine often requires a longer run, and is apt to land more heavily. Biplanes and low-wing monoplanes, therefore, are more suitable for service in the tropics, where the air is thinner and offers less support for a machine.

Probably the greatest difference between the two types of machine lies in the construction of the wings, for in a monoplane these have to be much stronger, and consequently a good deal heavier, than those of a biplane. The wings of a biplane can be of small section, and they are usually braced together with struts and wires, thus helping to support each other; in a monoplane, on the other hand, it is only possible to have struts from the wings to the fuselage. In many monoplanes these struts are dispensed with, the wing being constructed on the cantilever principle, which results in the stresses on one half of the wing being compensated by stresses on the other half, instead of being entirely transferred to the fuselage. In the cantilever type of machine the wing is usually very thick, and the absence of struts makes the machine cleaner, and enables it to be streamlined better than a biplane or a braced monoplane. Another point is that the cantilever machine is easier to maintain in flying condition, as there are no wires to be kept up to the correct tension, a task that needs trained riggers if it is to be carried out properly.

The foregoing may be regarded as a fair statement of the comparative merits of the biplane and the monoplane, but there are many machines that are exceptions to the general rules. The Hawker " Super Fury," for instance, is a biplane, but it has a speed of more than 250 m.p.h.; while the Fairey Long Range Monoplane was able to carry on its famous flight to South Africa a very heavy load, consisting mostly of petrol, and also to break the existing endurance record. In the case of the Fairey machine, however, a very long take-off run was required, and the aerodrome at Cranwell was the only one in the country from which the flight could have started.

Two machines that eventually should add a good deal to our knowledge about the relative qualities of the monoplane and the biplane have been produced by the Blackburn Aeroplane and Motor Co. Ltd., to the order of the Air Ministry. These are the Blackburn twin-engined civil general purpose monoplane and biplane, and they represent the first serious attempt to gain information with a biplane and a monoplane that are really

comparable. The machines are identical in all respects but their wings, the same fuselage, undercarriage and engines being employed. They are not freak types, but are suitable for general commercial operation, accommodation being provided for 10 passengers and their luggage, equivalent to a paying load of 2,000 lb., in addition to full equipment. The machines are suitable for service either as land or seaplanes, and have been designed to give the maximum degree of safety obtainable and to satisfy all the requirements necessary to obtain the "British Certficate of Airworthiness of Public Transport Machines for Passengers, Mails or Freight."



The Blackburn Civil Biplane, which has been developed to gain information concerning the comparative merits of the monoplane and the biplane. It is 64 ft. in span.

It is impossible at the moment to draw any conclusions about the two types as they have not been in service long enough. It is interesting to know, however, that the monoplane has a top speed at sea level of 124 m.p.h. and at 15,000 ft. of 120 m.p.h., while the figures for the biplane at the same heights are 123 and 117 m.p.h. respectively. The monoplane lands at 57 m.p.h. and the biplane at 60 m.p.h., while the service ceilings of the two machines are 14,600 ft. and 11,000 ft. When cruising at sea level and 110 m.p.h., the ranges are 356 miles and 352 miles respectively. The all-up weight of the biplane is 12,145 lb., while that of the monoplane is 12,580 lb., which makes the power loading of the biplane lower, and probably will enable its engines to last a little longer. The difference in the weights is due to the difference in the wings, the actual wing structure of the monoplane weighing 2,621 lb. and that of the biplane 2,154 lb. The fuselage of the biplane is 36 lb. heavier and the tail unit is 18 lb. lighter, but all the other weights are practically equal in both types.



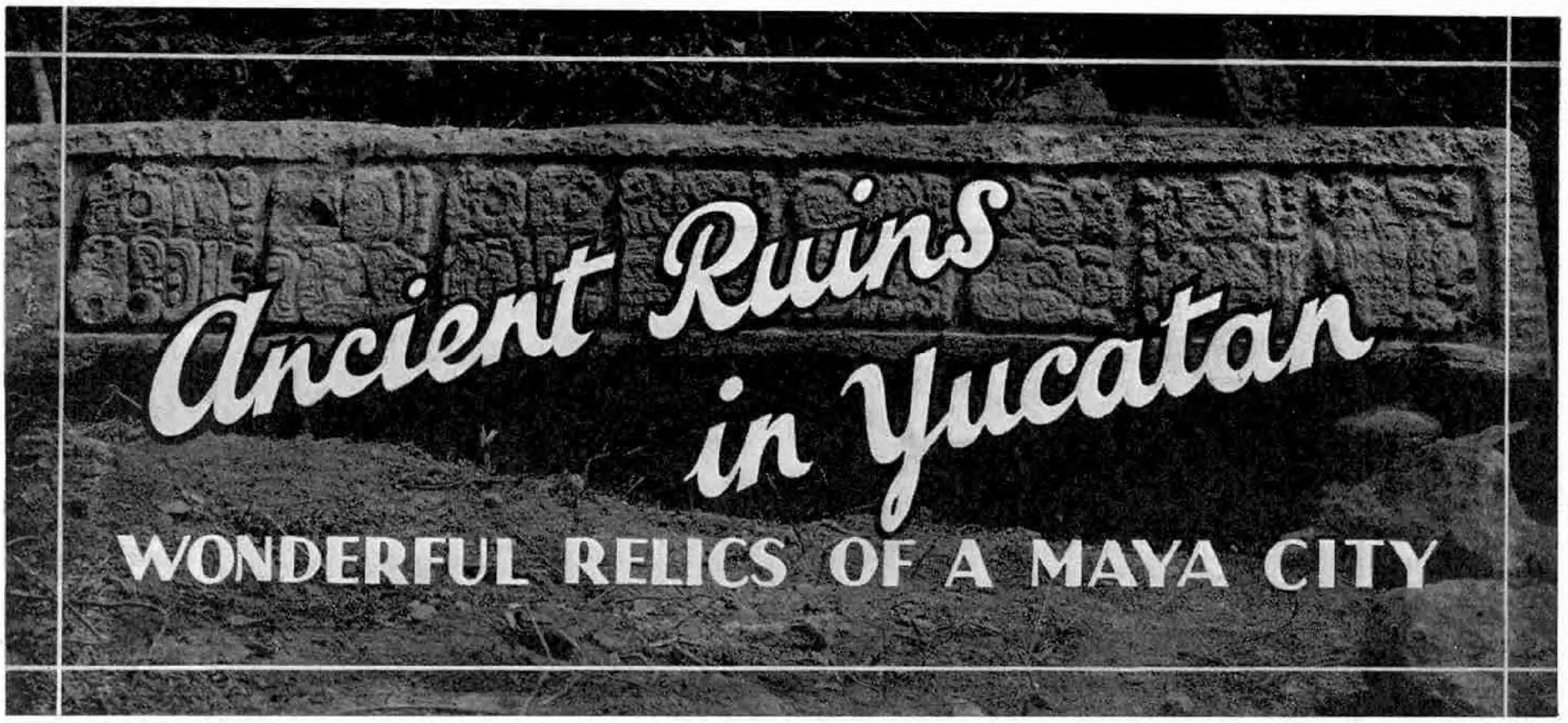
This photograph of the Blackburn Civil Monoplane shows the streamlined fuselage that is also used in the biplane illustrated above. The monoplane has a span of 86 ft.

Both machines are of the all-metal type, except for the lifting and control services, which are covered with fabric as this is easier to open up at any point as required for the annual renewal of the Certificate of Airworthiness. It is also considered that a complete renewal of the fabric once during the life of the machine will be a much cheaper and more satisfactory operation than would be the renewal of a metal cover.

The fuselage is of streamline shape and is built entirely of duralumin except for a few stainless steel fittings to carry high loads. The skin is formed from corrugated Alclad sheet, supported by bulkhead frames at close intervals and reinforced by longitudinal members running the whole length of the cabin. Throughout the whole of the design the points aimed at have been simplicity and accessibility for construction, inspection and maintenance, particular attention being given to the anchorage of components so that they can be removed for repairs easily and without disturbance of other parts of the structure.

The pilot's cockpit is in the front of the fuselage, and a good forward and downward view is obtained from it at all altitudes of the machine. Dual controls are fitted, and roomy proportions allow a clear passage between the pilots, either of whom has easy access to the cabin at any time through a door in the side of the luggage compartment, which is immediately behind the cockpit. The pilots can gain access to the cockpit also by means of an external door that makes it unnecessary to pass through the cabin. Although the cockpit is enclosed, it is light, the roof being transparent to give a rearward and upward view. Two large panels that can be pushed backward are provided in the roof to form emergency exits.

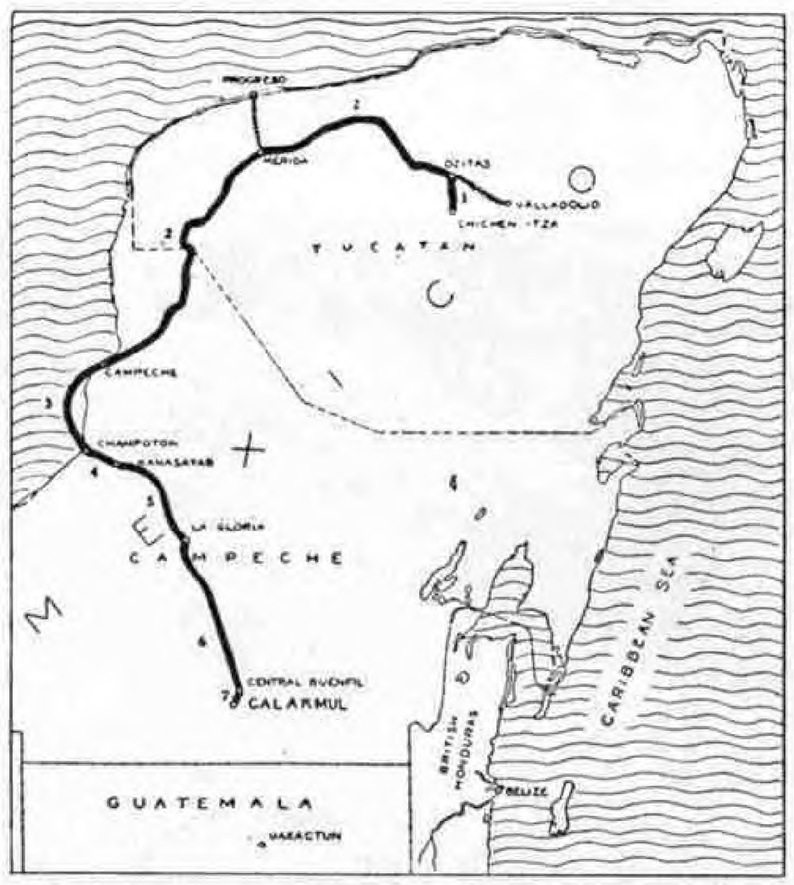
In the luggage compartment there is 12½ cu. ft. of space available for each passenger's luggage, and in addition 100 cu. ft. that can be used for mail or freight. Behind the luggage compartment is the passengers' cabin, with seats for 10. An abundant supply of fresh air is important to combat any tendency to air sickness, and each passenger's supply may be personally controlled.



THE ancient Maya metropolis of Calakmul, buried in the depths of the vast tropical forests of the Yucatan Peninsula in the southern part of the State of Campeche, Mexico, was first brought to the attention of the outside world by a young Texan botanist, C. Longworth Lundell, who visited this group of ruins in December, 1931. Lundell obtained his information as to the existence of this buried city from *chicleros*, or chewing-gum hunters, who had discovered it some six years earlier when the region was first generally explored for chicle, the chewing part of chewing-gum. In these great uninhabited forests it is literally true that the scientist, be he archæologist, botanist, or zoologist, must follow the chewing-gum trail, since to-day the only business that calls men into these remote and trackless wilds is the search for the *chico sapote* tree, the milk of which, when boiled, solidifies into pure chewing-gum.

Lundell, perceiving the scientific importance of the forest-grown ruin, the very name and existence of which had long since passed from the memory of men, photographed some of its principal buildings and sculptured monuments, and made a preliminary sketch map of the central section of the ancient city. The two highest pyramids, each 150 ft. in height, their steeply sloping sides covered from base to summit with dense tropical vegetation, look for all the world like two wooded hills, which suggested the name "Calakmul" given by Lundell to this former centre of ancient American population. A free translation of this name would be "City of the Two Adjoining Hills."

As a result of the photographs taken by Lundell the Carnegie Institution of Washington decided to send an expedition under Dr. S. G. Morley to Calakmul from Chichen Itzá, Yucatan, the Institution's archæological field base for the northern half of the Maya area. Official permission for the expedition was readily granted by the Mexican Government authorities concerned, and on 3rd April, 1932, the expedition started from Chichen Itzá, its personnel being Dr. and Mrs. Morley, Mr. Carl Ruppert, archæologist, Mr. John S. Bolles, architect and surveyor, Mr. Gustav Strömsvik, engineer, and two native assistants.



Map of Yucatan, showing the position of the ancient city of Calakmul. The heavy black line indicates the route from Chichen Itzá followed by the expedition of the Carnegie Institution of Washington, to which we are indebted for our illustrations.

The journey from Chichen Itzá to Calakmul (see heavy line on the accompanying map) was long, circuitous, varied and exhausting. Whereas the air-line distance between the two points is probably not more than 125 miles, the route that had to be followed was thrice that distance, and took nearly a week, during which no less than seven different methods of transportation were employed. The first lap (marked 1 on the map) was by Ford station wagon from Chichen Itzá to Dzitas. The second lap (No. 2 on the map) was by train to Mérida, capital of the State of Yucatan, and on the next day to Campeche, capital of the State of the same name. The third stage was by sea in a sailing boat that was equipped with an auxiliary petrol engine, south along the coast from Campeche to the town of Champoton at the mouth of the Champoton River (No. 3 on the map).

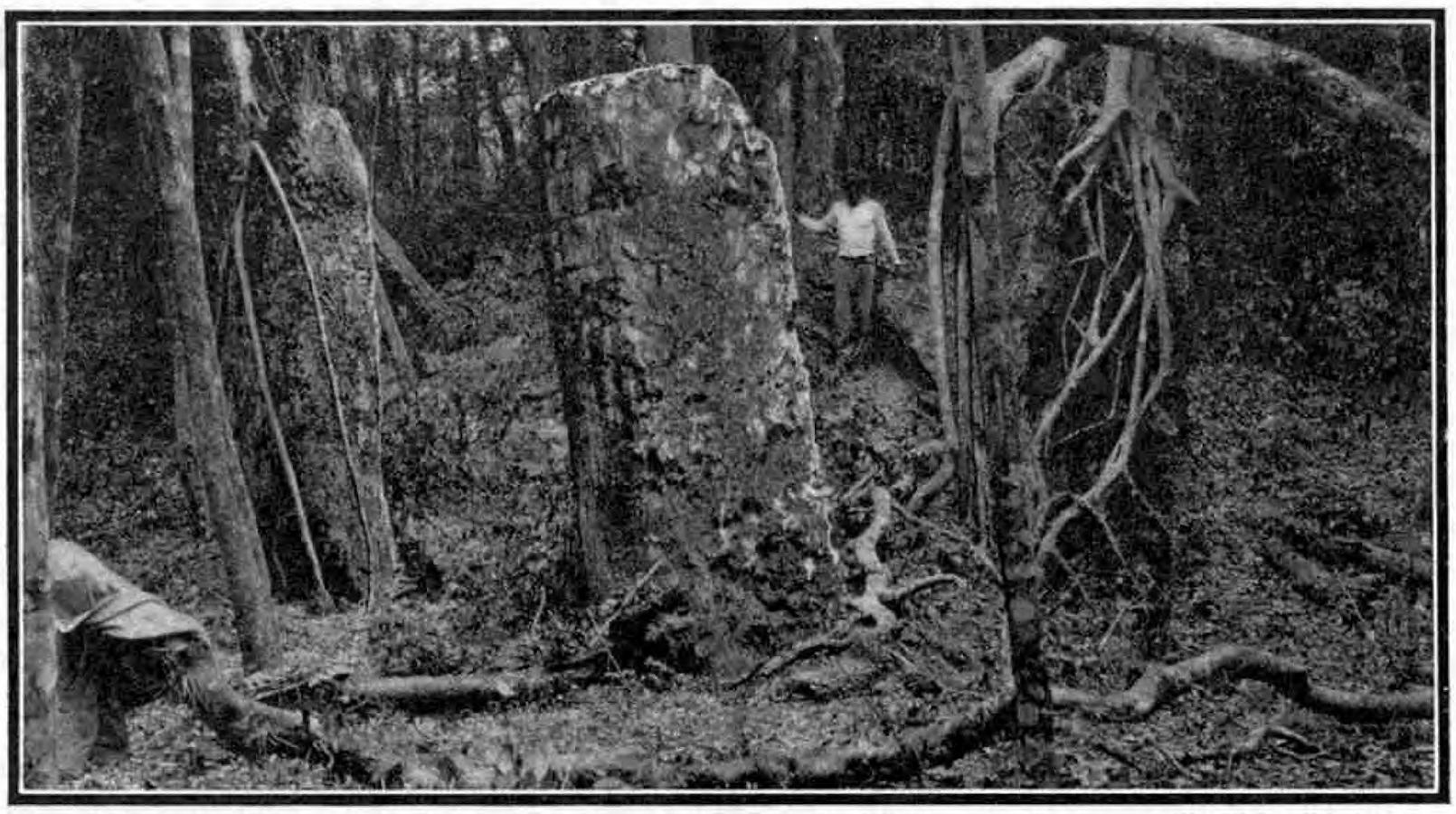
The fourth stage was by motor boat up the Champoton River to the village of Kanasayab (No. 4 on the map) where the expedition transferred itself, outfit and personnel, to a novel kind of conveyance known locally as platformas, that is platform cars drawn by mules. These platform cars run on tram lines, and are used in bringing out blocks of chicle from the interior to the nearest streams where they are re-shipped to the United States and made into the chewing-gum of commerce. Each platform is drawn by two mules, harnessed tandem by a single pair of traces to the car, and driven without reins. The only brake is a pole thrust against the

wheel, and braced against the frame of the platform. The track is in wretched condition, weaving a tortuous serpentine trail through the forest. The mules, unchecked by brake or rein, go like mad, and the expedition's five platforms successfully maintained an average of one derailment per car per hour.

This fifth lap of the journey (No. 5 on the map) ended at a place called La Gloria, "Glory" in English, though not in fact—a collection of flea-infested thatched huts, where dogs, pigs and chickens had the right of way, and sleep was not to be had. Here a change was made from the platform cars to a five-ton White truck for the sixth lap (No. 6 on the map), a 70-mile stretch through the rain-forest south and slightly east to Central Buenfil, the centre of the chicle operations of Mr. Francisco Buenfils, of Mérida, Yucatan, the Chicle King of southern Campeche.

The road from La Gloria to Buenfil, if indeed it may be called a road, is only an ungraded narrow clearing through the forest. Across the swamps this clearing is as much as 100 ft. wide, so that the Sun may dry out the flooded low-lying areas as quickly as possible after the rainy season; but across the higher ground the road is only wide enough to permit the trucks to lumber through without hitting the trees on the sides, or the branches above. In these places the road is little more than a tunnel through the forest, roofed by the tangled interlacing confusion of the branches overhead. Through this forest the truck fought its way over stones and through swamps, occasionally bogging down completely and having to be pried out with logs, chains and poles, but always managing to extricate itself from seemingly impossible situations. The body plunged and jerked from side to side until it seemed as though man-made machines could no longer stand the strain, but still the truck jolted onward. After 24 hours of this physical abuse Central Buenfil loomed as a blessed haven of static rest, no motion, no noise, no straining of tortured muscles.

That same evening, 8th April, Dr. Morley made arrangements for a mule train of some 30 mules, including the pack animals, which next morning carried the expedition the remaining seven miles to the ruins of Calakmul (No. 7 on the map). Camp, consisting of tent covers to keep out the rain, was pitched on the same afternoon in the forest-grown principal plaza of the ancient city, and intensive exploration began next morning, 10th April.



Three sculptured monuments standing in front of one of the pyramids at Calakmul. The one on the right has a wild fig tree growing on it.

Lundell on his preliminary map made at the end of December, 1931, had located 62 sculptured stone monuments, some fallen, but more still standing. Great trees were growing on top of many of them, as indeed over every court, plaza, pyramid, terrace, temple, and palace in the ancient city. Indeed, so thick was the undergrowth that one could pass within 100 ft. of the highest pyramid and never suspect its existence. The Carnegie Institution expedition during its two weeks' stay at Calakmul located 41 additional monuments, bringing the total to 103, this number exceeding by as much as 20 per cent. the number previously found at any one city of the Maya civilisation.



A large sculptured monument at Calakmul erected in either 472 or 731 A.D., and representing a ruler or priest with a spear in his right hand.

Dr. Morley was able to identify 51 Initial Series, one of the methods of dating used by the ancient Maya, and he deciphered the dates of some 45 of the 103 monuments. In the light of the dates presented by its hieroglyphic monuments Calakmul stands revealed as a city that flourished during the latter half of the Old Maya Empire, that is according to one school of Maya archaeologists, from 364 to 551 A.D. or, according to another school, some two-and-a-half centuries later.

During the exploration of the city an ancient quarry was found, where two large blocks of stone are to be seen side by side just as they had been left partially quarried out by the long-forgotten builders. In another court a huge flat outcrop of the native limestone, 21 ft. long by 15 ft. wide, had been completely sculptured with figures of six prisoners with their arms bound behind their backs with ropes.

We are indebted to the courtesy of the Carnegie Institution of Washington for the information in this article.

Automatic Road Traffic Control

Progress of the Electro-matic System

IN the May, 1933, issue of the "*M.M.*" we explained how the earliest form of mechanical traffic signalling robot, the fixed-time cycle lantern, was being superseded by the vastly more efficient Electro-matic vehicle-actuated signals. The principle on which these signals work represents a definite advance on that of any other system, and it ensures obvious advantages for both road users and the authorities responsible for the roads. It is not surprising, therefore, to find that, since the inauguration of the first European installation at Cornhill, London, in March, 1932, more than 400 intersections throughout the British Isles have been equipped with these signals. Numerous overseas centres also have adopted the system, including Paris, Berlin, Brussels, Milan, Antwerp, Johannesburg, Sydney and Durban. In addition there are more than 600 installations in operation throughout Canada and the United States.

As has been previously explained in considerable detail, the difference between Electro-matic and the fixed-time signals lies in the fact that whereas the latter apportion right-of-way to the intersecting roadways arbitrarily, without reference to the traffic conditions obtaining at the moment, the former are operated by the vehicles themselves passing over pressure-operated detectors sunk in the approach roadways at suitable distances from the crossing. Thus it is always assured that the "stop" and "go" periods are given to the various highways strictly in accordance with the traffic flow, and that a vehicle is never delayed unnecessarily or for longer than its own safety demands. Further, the signals do not change in the absence of traffic on either road.

The year 1933 was remarkable for the rapid spread of the apparatus throughout the country, and its adaptation to many intersections of a complexity and intricacy far removed from the straightforward crossing of which the first European installation was typical. Local authorities realised in increasing numbers the advantages and possibilities of the system, and after experimenting with a single installation, invariably placed orders subsequently for equipment at many of the most difficult traffic points in their areas. London already has more than 100 intersections, and by further installations it is proposed to release for other duties by the end of this year point policemen from 600 additional crossings in the area.

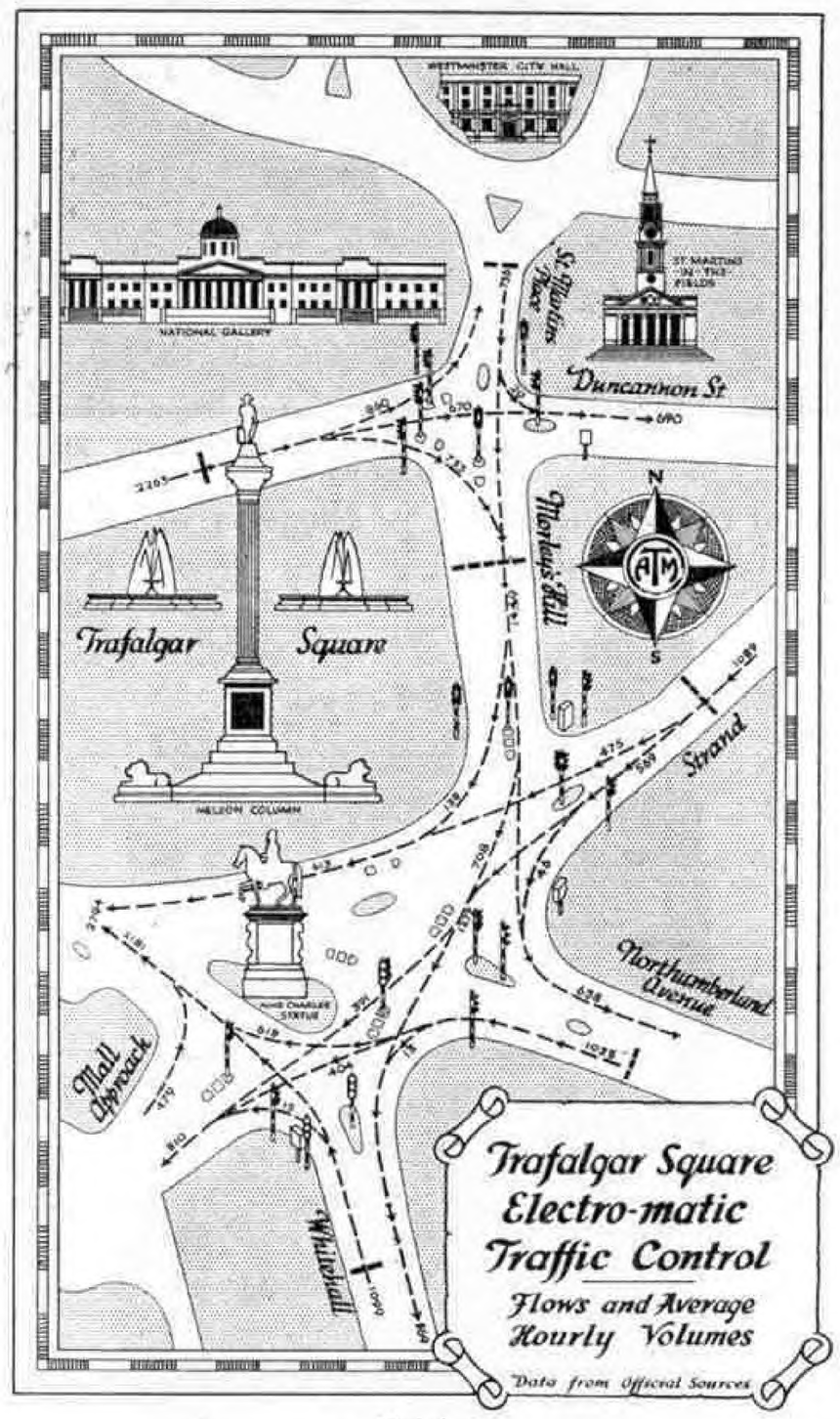


Fig. 1.

Electro-matic vehicle-actuated signals are controlling hundreds of simple + intersections, but it has been clearly demonstrated during the last few months that their application is by no means restricted to these. Crossings and junctions presenting apparently insuperable obstacles to efficient automatic control have been successfully dealt with. While a straightforward + crossing is controlled in two "phases," that is to say right-of-way is apportioned to two routes, the complication of one or more additional routes renders extra phases necessary and, in certain circumstances, peculiarities of layout demand modification of the normal order of the phase working. The essential ingenuity of the system is clearly shown in practice by the fact that no matter how many phases or special features are incorporated, none is brought into play until traffic conditions call for it. Moreover, it has been found that all intersections, even the most complex, fall into one or other of a limited number of broadly defined classes. Consequently standardisation of control equipment and mechanisms has been developed, and this considerably assists the application of Electro-matic signals to any form of road junction.

Fig. 2.

In several instances the peculiarities or complexities of the local conditions have necessitated the incorporation in the control equipment of special features to prevent congestion, or some other equally serious trouble. A good illustration of this is furnished by the Electro-matic signals in service at the Seaforth and Bootle (Lancashire) boundary shown diagrammatically in Fig. 2. This six-way intersection is one of the most complex traffic points in the North of England, and is formed by a narrow main route passing under a wide railway arch, and intersected on both sides of this by important side roads. Congestion under the arch was rife and had to be eliminated; and consequently a special "hurry"

call feature was incorporated in the signalling mechanism designed for the intersection. Main road traffic, on crossing the detectors, makes a hurry call to the signals on the far side of the bridge, and so ensures that in no circumstances can the stretch of roadway underneath the bridge become blocked to the detriment of vehicles on the side roads.

The most important and certainly the most spectacular achievement in automatic traffic control is the successful application of Electro-matic signals to Trafalgar Square and Piccadilly, London.

The Electro-matic installation in Trafalgar Square carries on the co-ordinated police system of control that it superseded, and at the same time adds a certain flexibility that is peculiar to the equipment. A one-way system is in operation, traffic moving in a clockwise direction, and the main control problems arise at the north-east and south-east corners, particularly the latter, where such important thoroughfares as the Strand, Northumberland Avenue, Whitehall and the Mall enter the Square and increase the difficulties by virtue of their mutual interfering streams. The figures in Fig. 1, showing the traffic volumes, give some idea of the complex nature of the intersecting streams, and indicate clearly how rapidly congestion and confusion would arise in the absence of really efficient control.

The Electro-matic installation in Piccadilly, in the stretch of Duke Street to Stratton Street, is remarkable as being undoubtedly the most difficult problem that has yet confronted the engineers. In addition to providing great difficulties by reason of the arrangement and proximity of the intersecting streets, the locality is generally regarded as one of the worst, if not the worst, traffic spots in London, because at certain hours both main and cross streets carry traffic to their maximum capacity. Each intersection is controlled individually, having its own lanterns, detectors and controller, but in addition, the complete installation is provided with an overall system of automatic linking. This system, under certain conditions of traffic density on the main thoroughfare, Piccadilly, superimposes what is known as a flexible-progressive plan of operation to ensure the utmost expedition in the movement of traffic.



The Electro-matic installation in Piccadilly, one of the worst traffic spots in London. For the illustrations to this article we are indebted to the Automatic Electric Co. Ltd., Liverpool.

The flexible-progressive method of working is a scheme devised originally in conjunction with the fixed-time traffic signals, by which a number of consecutive intersections, spaced throughout the length of a main highway, are co-ordinated with the object of speeding up the flow of vehicles. If each crossing in turn is regulated entirely independently of its neighbours it is obvious that traffic will move forward in a series of irregular jerks, liable to stoppage at any or all of the signal points, and considerably increasing the time taken to traverse the whole route. To obviate this drawback the controllers at each intersection are progressively adjusted, based upon on average speed of traffic along the main road. This means that a vehicle or group of vehicles can traverse, at this average speed, the entire length of the main highway without stoppage, for the signals are timed to give immediate right-of-way on arrival at each intersection.



Trafalgar Square, London, another Electro-matic controlled point. The photograph shows the imposing South Africa House, and next to it the famous church of St. Martin-in-the-Fields.

A co-ordinating "master timer" incorporated in the control equipment operates when the traffic density along Piccadilly itself reaches a certain maximum to time the signals at the successive intersections progressively, and to provide that the interruptions from the side approaches take place in some specified order. As soon as the flow of vehicles in the main route lessens, and the necessity for flexible-progressive control ceases, the signals revert automatically to normal working.

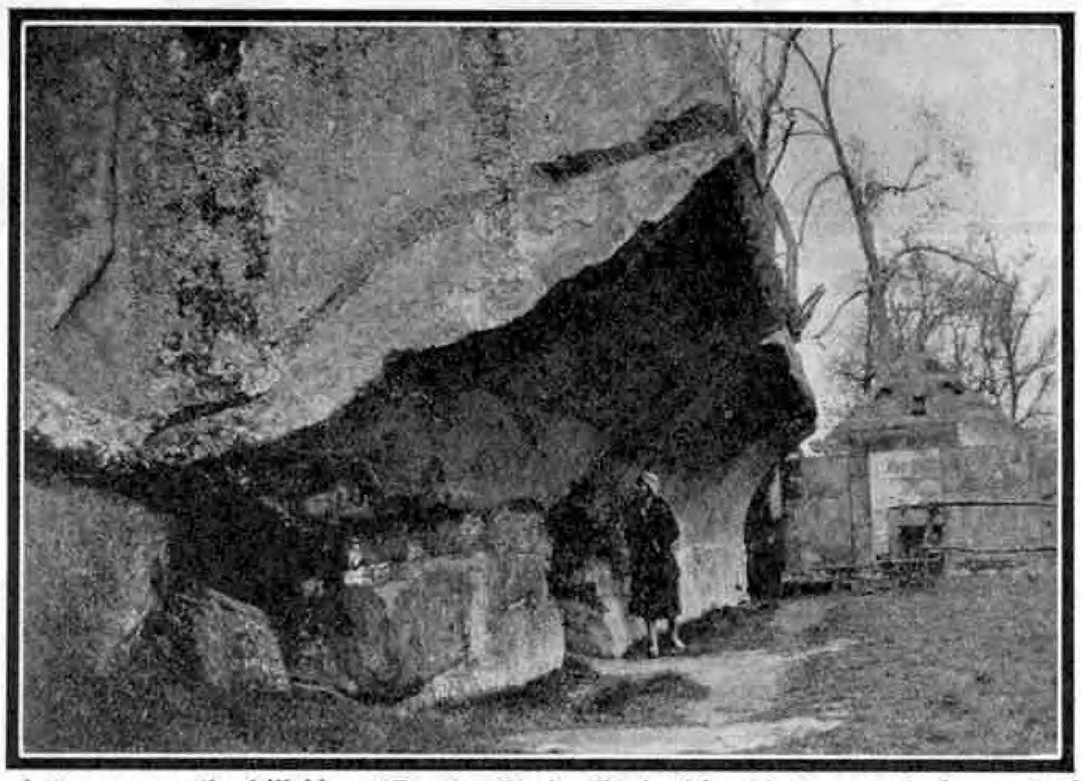
With two such problems already solved, any traffic point can confidently be left to Electro-matic control.



These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

A Druid Cathedral in Derbyshire

Recently I spent an interesting time among the wonders of Rowtor Rocks, at Birchover in Derbyshire. These lie just off the main road between Ashbourne and Bakewell, and are approached through the grounds of the Druid's Inn, from which a path leads to the entrance of a cave. Not far away from the opening is a stone seat cut in the rock, and a few yards beyond this is a large square font or basin, standing on a square dais that is approached by means of three steps, also cut in the solid rock. Strange carvings and mystical signs can be seen on the face of the rock in several places.



A terrace on the hillside at Rowtor Rocks, Derbyshire, that can only be reached through the cave seen on the left. Photograph by W. C. Wilkinson, Sheffield.

On entering the cave I found myself in an underground passage, along which I passed to emerge on a terrace cut on the precipitous side of the hill. As the accompanying photograph shows, this terrace has a natural canopy of overhanging rock. The lady seen in the illustration is looking into a square chamber, hewn in the rock, from which a stairway has been cut along a fault to penetrate to another terrace on the opposite side of the hill.

The most remarkable feature of the second terrace is a huge stone that seems immovable, but can be made to oscillate when two or more persons push it with their hands from opposite sides. If the pressure is kept up long enough the stone can be rocked quite vigorously.

Steps lead from this terrace to the summit of the hill, on which is a stone pillar surmounted by an iron rod. The summit takes the form of a ridge, at the end of which are three great chairs that have been shaped out of the rock. Mysterious carvings abound, and practically every rock at the summit has had a square socket cut into it. Little is known of the reason for the elaborate carvings that make Rowtor Rocks so remarkable, but it is believed that the hill was once the scene of Druid rites, and the remains have been described as the ruins of a Druid cathedral.

W. C. WILKINSON (Sheffield).

Filling the World's Largest Graving Dock

Last June I visited the dock extensions at Southampton in order to see the new graving dock, which had just been completed. This dock is the largest of its kind in the world. It is 1,200 ft. in length, has an entrance 125 ft. wide, and will be capable of accommodating a vessel of 100,000 tons if such a monster liner is ever built. More than 2,000,000 tons of earth were excavated during its construction and the floor and walls contain about 750,000 tons of concrete.



The stream of water that filled the new graving dock at Southampton on its completion. Photograph by P. Atkinson, Southampton.

At the time of my visit the dock was being filled, and I secured the accompanying photograph of the stream of water pouring into it through a pipe 2 ft. in diameter from the single pump then at work. This pump filled the great basin in 72 hours, and during that time it poured 260,000 tons of water into the dock. Pumps were installed later for use when the dock is in operation and these can empty the dock in four hours.

Workmen were busily engaged clearing the entrance of the dock from the gravel that separated it from the main waterway and many other preparations were being made for the fitting of the giant gate, which was described on page 413 of the "*M.M.*" for June of last year. When filled with water ballast it weighs about 4,600 tons, and more than 1,700 tons of steel plates were used in its construction. It was towed from the Tees to Southampton and was floated into position after my visit.

P. ATKINSON (Southampton).

Zanzibar Visited by Sea Monsters

On 2nd December of last year the people of the historic island of Zanzibar received a surprise visit from 54 huge sea mammals. The first news of the event came from the villagers of Mtoni, which is three miles from the city of Zanzibar. They reported that in the early morning many black whales had taken refuge on the beach there, and had been left stranded when the tide receded.



Whales stranded on the beach at Mtoni, in the Island of Zanzibar. Photograph by Mohomed H. Sheriff, Zanzibar.

Crowds of people immediately went to Mtoni to witness this unusual sight. It was very pathetic to see these powerful monsters of the sea lying on the sand, panting heavily and bellowing as they slowly died. Practically every whale had a bruise on the back, and this suggested that they had been chased by an unknown enemy that had forced them ashore.

The presence of so many carcasses on the beach promised to create an intolerable nuisance, and employees of the Health Department therefore dragged as many of the creatures as possible into the water, to enable them to take advantage of the return of the tide. To our astonishment most of these returned ashore as soon as they were released, and next morning the bodies of the mammals were strewn along the beach. The question of their disposal then became acute. Some of them were buried and the rest were burned to ashes.

I learned that the whales were of the kind known as "false killers." These are toothed whales, having from eight to ten pairs of large teeth in each jaw, and they are said to feed almost entirely on cuttlefish.

MOHOMED H. SHERIFF (Zanzibar).

The Mystery of the "Electric Brae"

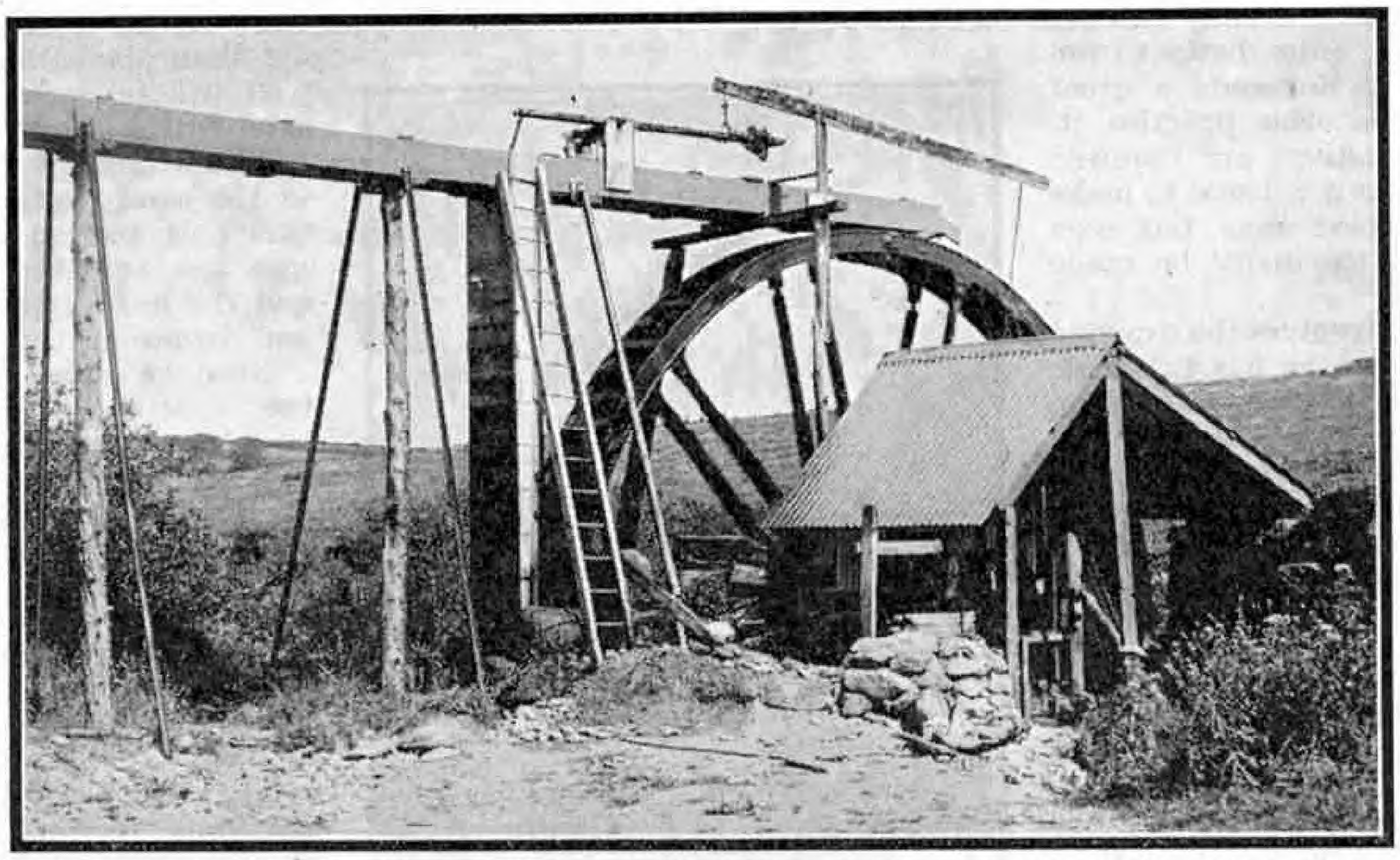
In Ayrshire, Scotland, there is a hill on the road between Maybole and Ayr that is known as the "Electric Brae." The reason for this is that on it cars appear to run uphill when the clutch is out and the brakes are off, and it has been suggested that magnetic or electric forces are the cause of this apparent impossibility. While on a visit to Scotland last summer I determined to test the matter for myself, and for this purpose took with me a reliable spirit level.

On arrival at the hill, the car in which I was travelling was stopped and the brakes were then taken off, leaving it free to move. It rolled slowly in what seemed to be the uphill direction, and a rubber ball placed in the middle of the road ran the same way. At the same time, I noticed that it was more difficult to walk "downhill" than "uphill." I then laid the spirit level on the road and this showed quite plainly that the road slopes downhill in the direction followed by the car when left free and by the rubber ball. Thus it is unnecessary to call in the aid of magnetism or electricity, for the apparent slope of the hill is an optical illusion, presumably due to the character of the surrounding country. The illusion is very effective, for the slope seems to be in the wrong direction from whatever angle the road is viewed.

R. K. REID (Crosby).

An Old Cornish Waterwheel

While in Cornwall a short time ago I discovered the interesting old waterwheel of which a photograph is reproduced on this page. At the time of my visit this wheel was a prominent landmark at Trink, in a valley between Lelant and Towednack, not far from St. Ives. Water brought down from the surrounding hills through a series of troughs was being led to the top of the wheel by means of a wooden conduit. There it flowed over the vanes and the extra weight thus brought to bear on one side of the great wheel caused it to revolve.



A Cornish waterwheel at Trink, near St. Ives, that until recently drove a stamping mill in which tin ore was crushed. Photograph by H. Hancock, Bath.

This interesting wheel was being used to drive a stamping mill for crushing tin ore that afterwards was placed on a wooden frame over which flowed a stream of water. Earthy impurities were then washed away, leaving the tin behind. Shortly after my photograph was taken the ore ceased to give paying yields of this metal and the plant fell into disuse. It has now been partly dismantled and probably will never be restarted.

H. HANCOCK (Bath).

A Continuous Casting Plant

Interesting Southern Railway Installation

AN interesting event at the Eastleigh Locomotive Works of the Southern Railway last year was the installation in the iron foundry of a continuous casting plant for the rapid and accurate production of iron castings. The introduction of this plant has given the Southern Railway Company the distinction of having the most up-to-date railway foundry in Great Britain, and has enabled the casting previously done by Ashford and Brighton Works, and by outside contractors, to be concentrated at Eastleigh.

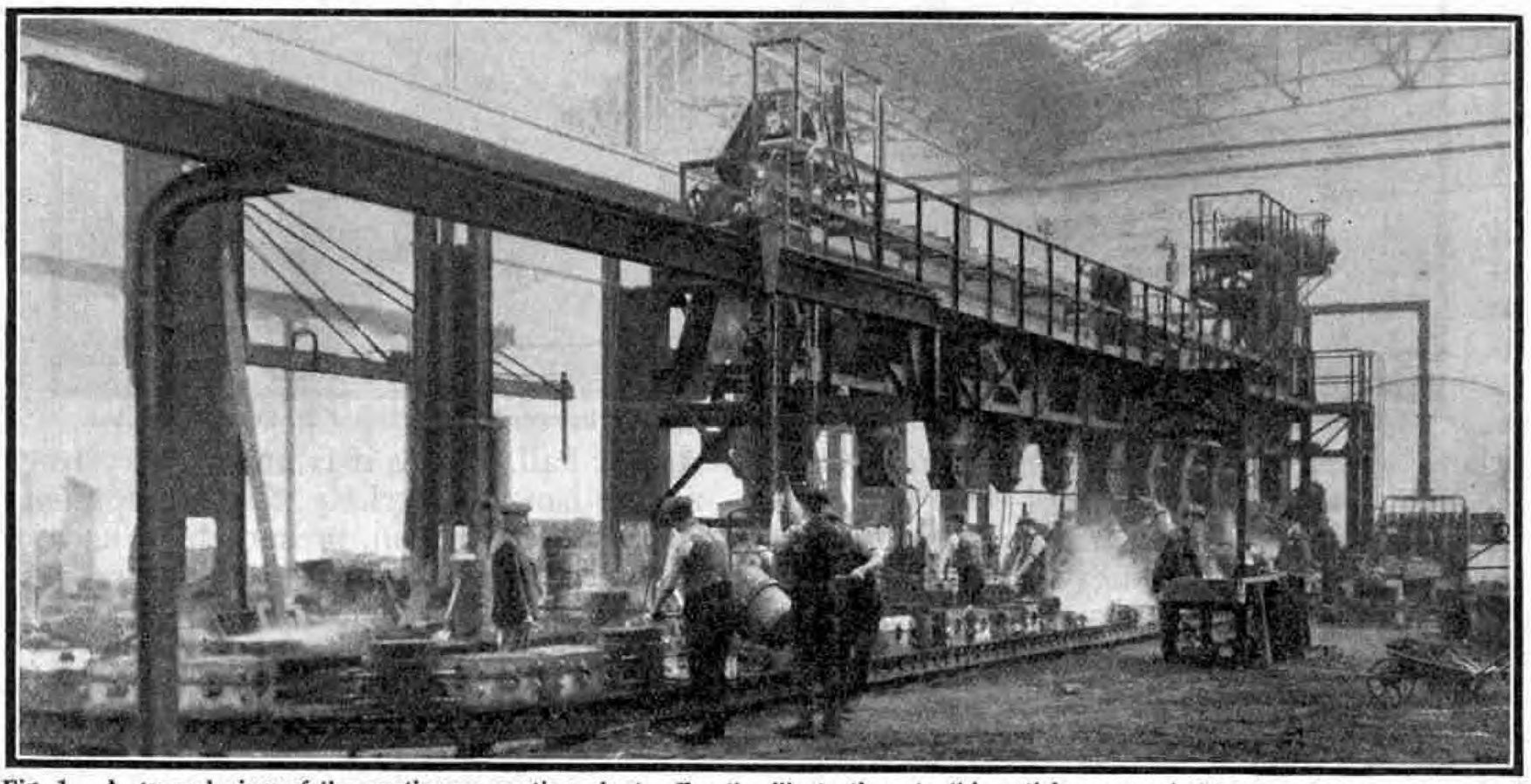


Fig. 1. A general view of the continuous casting plant. For the illustrations to this article we are indebted to the courtesy of the "Southern Railway Magazine."

Before describing this plant in detail it would perhaps be well to outline briefly how an iron casting is produced under the old hand moulding methods. First, a pattern of the required article is made, usually in wood. Pattern making is a highly specialised trade, quite distinct from ordinary carpentry, and it demands a great degree of skill from those who practise it. When large numbers of castings are required to be made from one pattern it is usual to make this of metal in order to resist wear, but even this metal pattern would originally be made from a wooden one.

When the pattern maker receives the drawing of the part that is to be cast, he has to decide first of all how the cast is to be made. Iron and brass are cast in what is known as moulding sand. Impressions in this sand are made by the pattern which, when removed, leaves cavities to be filled in with molten metal. The art of pattern making lies in arranging matters so that it is possible to withdraw the pattern without disturbing the sand. Another important point for the pattern maker is that the molten metal shrinks as it solidifies, and therefore if the pattern were to be made the exact size of the finished casting, as indicated on the drawing, the casting produced would be too small. For this reason all patterns are made larger than the required casting by an amount that is known as the "shrinkage." This varies for different materials, but is about $\frac{1}{8}$ in. in 15 in. for cast iron, and $\frac{1}{8}$ in. to $\frac{1}{4}$ in. in 12 in. for brass.

All but the very simplest patterns have to be jointed, otherwise they could not be withdrawn from the moulding boxes without disturbing the sand. Large patterns also have to be made with what is called "taper" or "draught," so that they can be lifted out without breaking down the sand. A machining allowance also is made where necessary to allow for machining those surfaces that are required to be perfectly smooth and accurate, as, for instance, for the bedding of cylinder covers. This allowance will be indicated on the drawings.

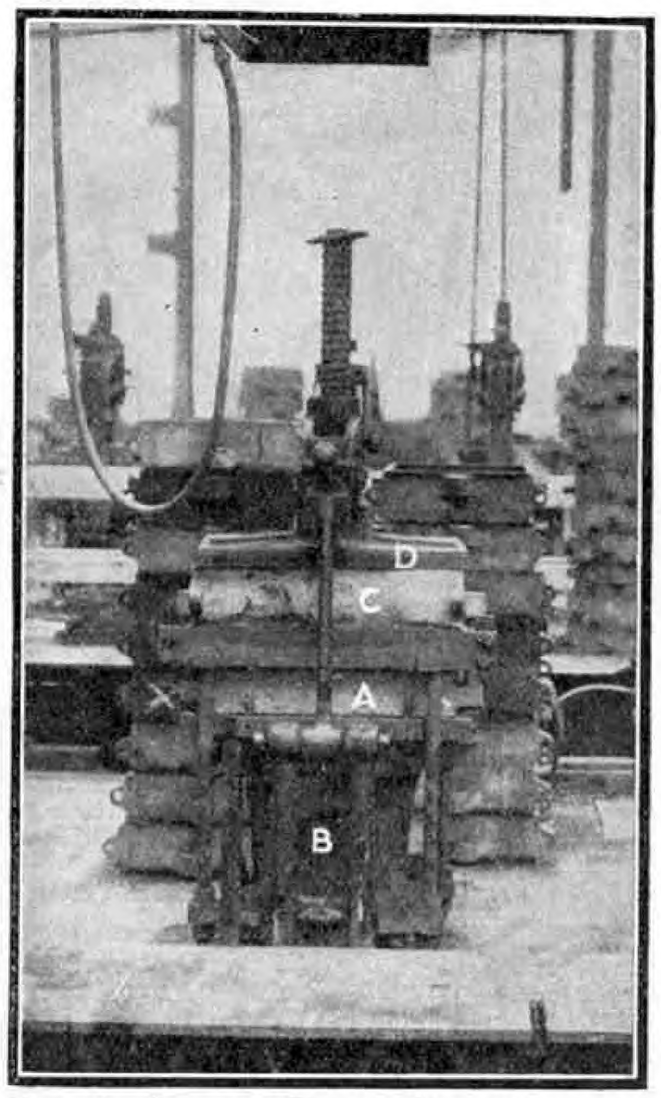


Fig. 2. The moulding machine under each hopper.

When the pattern is made it is sent to the moulders. Moulding also is a highly skilled art that does not generally receive the recognition due to it. Let us suppose that a pattern is made in two parts. The moulder places one half of it in an iron box that has four sides but no top or bottom. This box is placed on a flat surface and filled with special moulding sand, which must be damp enough to make it workable, but not so wet that the hot metal will produce dangerous amounts of steam. The sand is rammed tightly round the pattern, and the box is then turned over and the pattern extracted, leaving behind a corresponding impression in the sand. The other half of the pattern is treated similarly in another box, and the two boxes are then placed together.

It will be seen that there is now a box of sand with a cavity in the middle corresponding to the article required. A hole is then made in the sand leading to the cavity, and down this hole molten iron is poured. When the iron has set the mould is pulled to pieces, and the resulting casting removed for cleaning and trimming.

Now we come to the new method, that of the continuous casting plant. This plant has been designed to correct the following defects of the old system, namely, to eliminate (1) manual handling of sand; (2) the personal element in ramming the sand and removing the pattern from the box; (3) the possibility of using improperly sifted sand; (4) the necessity for carrying molten metal some distance from the cupola to individual moulds; (5) to reduce the time taken in making the moulds.

The accompanying photographs illustrate the new method, and explain the various stages in the working of the continuous casting plant.

Fig. 1 shows a general view of the plant. The moulding is done on moulding machines, of which 10 are shown in the centre underneath the 10 hoppers that supply them with sand. The whole is surrounded by a moving conveyor, on which the boxes are placed, and carried past the pouring station in the foreground, which is at the nearest point to the cupolas where the metal is melted. After being poured the moulds pass on along the conveyor belt, and at the opposite diagonal point to the pouring station are pulled apart and the castings placed on another conveyor for removal to the trimming shed. The sand is then mechanically transferred back to the hoppers, as described later.

When the moulds are pulled apart at the knockout grid the sand falls through a grating A, Fig. 3, into a pit, at the bottom of which is a moving belt. This belt deposits the sand on the vertical elevator B. At the top of this elevator the sand passes over a magnetic separator C, which removes all metallic particles and rejects them down the pipe D. The sand is then passed through a screen that rejects all the larger lumps into the hopper E, which is of large capacity to allow for cooling. From the bottom of this hopper the sand is now conveyed by the belt F, and deposited on the sand mill G. This mills the sand to the correct degree of fineness, whence it is conveyed by the elevator H to an aerator.

The aerator consists of a fast-running disc on to which the sand is dropped, and then flung outward by centrifugal action through a screen of wire nails, thus finally ensuring the thorough separation and aeration of the sand particles. From here the sand drops on to the flight conveyor that carries it along over the tops of the hoppers and fills them up ready for the moulder beneath. Fig. 2 shows the moulding machine under each hopper. This machine consists essentially of a table A mounted on a hydraulic ram B. The pattern—in these cases of metal—is mounted on the table, and the moulding box C placed above it. The moulder than opens his hopper valve, and sand falls into and fills the moulding box. The sand is then scraped off flush, and the head of the machine D is swung over into position, as shown, and locked. The pattern is then pressed upward into the sand by hydraulic pressure, and it drops away again when the pressure is released. The half of the mould is then placed on the mould conveyor, which carries it to the next machine.

Each half of the mould is made on a separate machine, so that in one case the half mould is placed direct on the conveyor, and in the other case it meets and is placed on top of its mating half. The moulds pass along, and are poured at the pouring station as previously described. The moulding boxes are of rolled steel or cast from scrap aluminium.

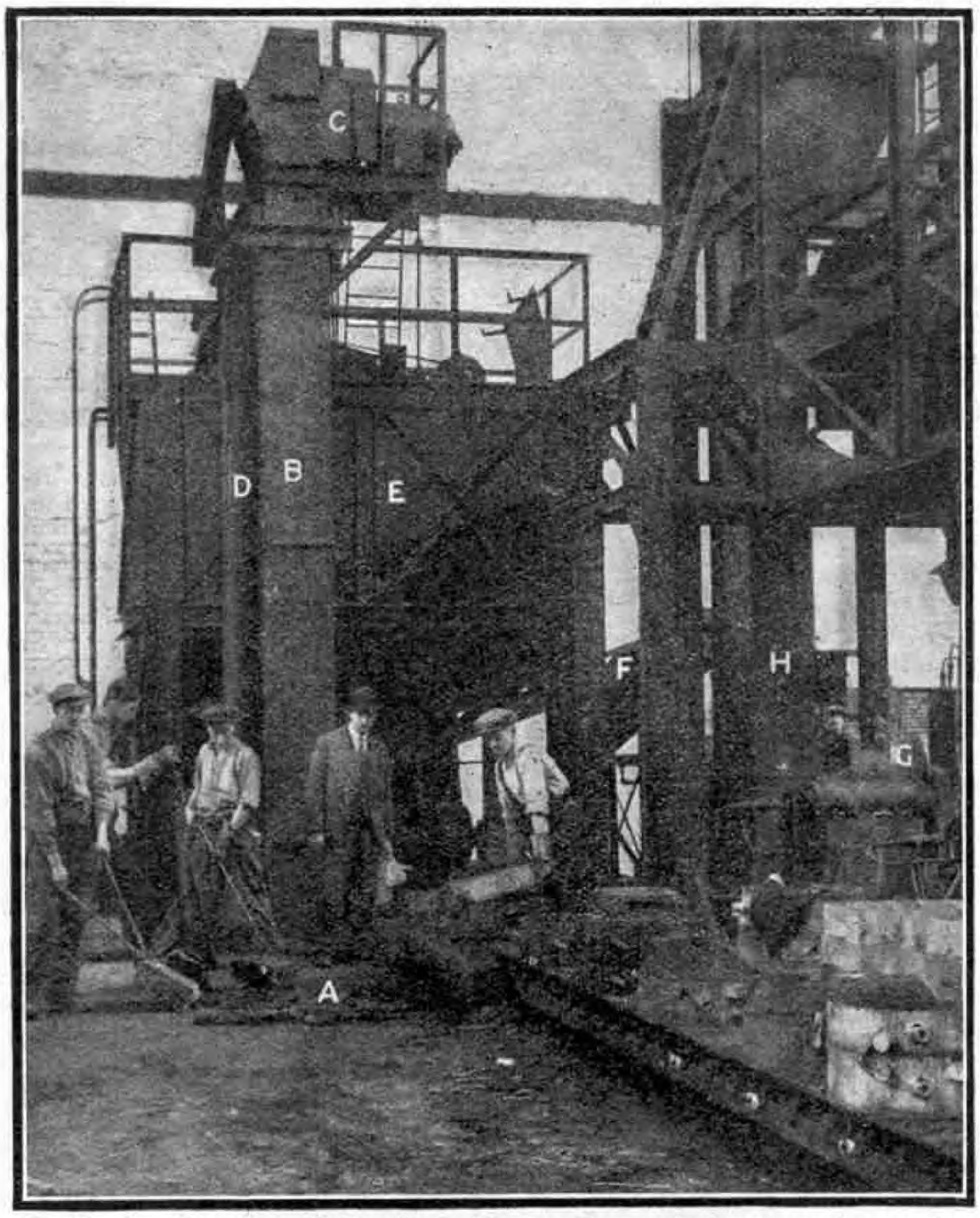


Fig. 3. Another view of the plant, showing the sand elevator and screening arrangements.

The chief work done on this plant consists almost entirely of brake blocks for locomotives, carriages and wagons; fire-bars for locomotive grates, and standard wagon axle-boxes. Occasionally, where sufficient quantities are required to justify machine moulding, carriage bogie and underframe parts are also produced.

The installation runs almost entirely on ball bearings and is lubricated throughout by grease-gun or totally enclosed oil baths. All the machinery for conveying and treating the sand, except the disintegrator and the riddle, runs at very low rates of revolution, and this reduces wear to a minimum. The hydraulic power supply is obtained from an accumulator and two-throw pump situated in the adjacent pattern shop. This situation is chosen for cleanliness, and for the sake of being close to the centre of supply, for moulding machines are operated also in the brass foundry, which is on the other side of the pattern shop.

There are three cupolas, one of which is in use all day. On the following day this one would be out of service and one of the others lit up, having been previously prepared overnight. Both the overhead monorail serving the continuous casting plant, and the trolley track leading to other parts of the foundry, pass in front of all the cupolas.

For our information concerning the technical details and operation of this interesting plant we are indebted to the "*Southern Railway Magazine*."

Model Building Results—(*Cont. from page 407*)

of the base Girders, and they are connected across their tops by a 7½" Strip. The vertical Girders are also fastened to the flanges of the 2½" × 3½" Flanged Plates by means of 2" Strips. The front of the garage is then filled in with vertical Strips, a space being left for the doorway. Two Flanged Sector Plates, bolted to the front of the garage, above the doorway, form the roof of the porch.

The petrol pump consists of two Sleeve Pieces, mounted on a Boiler End and fitted with a Crank for a handle. A 57-teeth Gear Wheel represents the electric sign globe on top of the pump.

Prominent among the entries in this Contest were several models of churches, particularly good examples of this type being submitted by N. Paola and K. Morton. The model constructed by Paola is based on the Emmanuel Catholic Cathedral at Durban, S. Africa, and is provided with a choir and organ loft formed by tiers of steps that lead up to the miniature organ. The organ pipes are represented by various sized Rods held in Meccano X Series Strips by Spring Clips.

The base of the building measures 44½" × 22½" and is filled in with 5½" × 2½" Flanged Plates, 5½" × 3½" Flat Plates and 5½" × 2½" Flat Plates placed alternately. At one end of the structure are two towers, and beneath them in the interior is a platform 12½ in. square raised an inch above the general level of the floor. On this platform are the Altar, Altar rails and the pulpit.

The roof of the building is supported on columns of two 12½" Angle Girders connected together.

A very neatly built model of Notrè Dame Cathedral was submitted by M. Roche, Paris. The main pillars on each side of the main entrance are built from Angle Girders and Flat Girders, and Braced Girders and Windmill Sails have been used to form the walls.

Really excellent work has been done in reproducing the carvings and mouldings that form such a conspicuous and beautiful feature of this famous cathedral, and in part of the model Curved Strips and Pulley Wheels have been used to good advantage. Unfortunately, owing to lack of parts, Roche has had to use cardboard for the roof.

How To Get More Fun—(*Cont. from page 419*)

are less powerful their loads must be somewhat less. The No. 1 Locomotives can be braked or reversed from the track only by means of the AB2 Curved Brake Rail, which is packed in the No. 1 Sets.

Although the No. 1 Special and No. 1 Locomotives are four-wheelers, their length of wheelbase is such that they require to be operated on 2 ft. radius curves in order to obtain the best results. They can traverse curves of 1 ft. radius, but their speed, hauling power and length of run are considerably reduced.

The Hornby No. O Tender Locomotive is similar in outline to the No. 1, but has not the outside cylinders of that engine. It can be operated successfully over 1 ft. radius curves, and is therefore a useful engine for miniature railways laid in restricted spaces. Better running still will be obtained on 2 ft. radius curves if these can be employed.

Similar characteristics are shared by the M3 Tank Locomotive, which is suitable for light local goods and passenger work. The M1 Tender Locomotive is slightly smaller, but like the No. O and M3 Tank is a "1 ft. radius" engine, and has a reversing mechanism. The reversing gear on these three engines cannot be operated from the track, however, but only by means of the lever in the cab. Their brakes are applied from the track by means of the BB1 Straight Brake Rail.

The MO Locomotive is the smallest engine in the Series, and is capable of covering a surprising distance for its size. It is essentially suitable for layouts laid with the special 9 in. radius rails. This locomotive cannot be reversed, but it has brake apparatus that can be operated from the cab by hand, or from the track by means of the special MB9 Curved Brake Rail.

As they are equally suitable for goods or passenger work, the No. 1 Specials both Tender and Tank, also the No. 1 Tender and Tank Locomotives, and the No. O Locomotive, can be obtained either in the goods or passenger styles of the real railway groups. Black is used for goods engines except on the G.W.R. where the same green as for passenger engines is employed. A choice of colours does not therefore apply in the case of Hornby G.W.R. Locomotives.

The M.3 Tank Locomotive is obtainable only in the passenger colours of the four groups and the M.1/2 and M.O Locomotives are each available in red or green.

The wheels of the M3 Tank the M1 and MO Locomotives are not coupled as are the driving wheels of the other engines. The power of their mechanisms is naturally limited and these locomotives are intended and commonly used on curves of small radius. Hence arises the necessity for avoiding the resistance that is set up when coupling rods are provided, in order to reduce friction and render the engines as free-running as possible.

Great Ports of the World—(*Cont. from page 368*)

coal hoists with lifts up to 76 ft. above water level, and 13 of these deal with 20-ton wagons. The general cargo quays of the docks carry a total of 27 swift working electric cranes and 34 modern hydraulic cranes, varying from three to 10 tons capacity; and one hydraulic crane capable of lifting 30 tons. In addition there are four two-ton hydraulic cranes on a wharf on the bank of the River Usk. Coaling jetties on the river bank are operated hydraulically and are provided with cradles that can be raised and lowered, enabling coaling operations to be continued over a long range of tides. There are spacious warehouses, storage sidings, and other facilities for dealing with exports other than coal and with imports of all kinds.

Turning to the trade of the port, we find that coal well exceeds all other exports, and 2,633,744 tons were shipped during 1933. Other exports include large quantities of rails, steel sleepers, wagons, coaches and other railway material; manufactured iron and steel of all kinds, patent fuel and many classes of general goods. Commodities brought into the port include iron ore, pitwood, timber and deals, and general merchandise.

The Newport Harbour Commissioners constitute the River Authority for Newport. They are responsible for the River Usk and its estuary and, jointly with the Great Western Railway, for the approach channel to the sea lock entrance to the docks.

We are indebted to the courtesy of the Great Western Railway for much of the information contained in this article.



British Railways' Increased Traffic

There are many cheering signs that after a period of decline the railways are coming into their own again. The latest returns show definite increases in passenger, mineral and general freight traffic, and already there are indications that records are likely to be broken in the course of this year's holiday season.

The rush of passengers during the Easter holidays made heavy demands on the resources of the companies. On the day before Good Friday some hundreds of special trains were run, and most of the principal expresses had to be run in duplicate or triplicate. Some, indeed, ran in as many as four, five, and even six portions. Huge trains were tackled unaided by L.N.E.R. "Pacifics" and G.W.R. "Kings," but on the L.M.S.R. there was considerable double-heading. In one instance noted a Liverpool–Euston express was drawn by a "Royal Scot" with a "Baby Scot" as pilot.

As usual the S.R. claimed a full share of the special holiday traffic, and their electric and steam services were greatly augmented. The various routes to the Continent were well patronised. On all the railways there was a certain amount of congestion and delay, and in a number of instances very late arrivals occurred. The railways must see to it that they are ready to deal with the increase of traffic they so keenly desire.

Locomotive Stock of L.M.S.R.

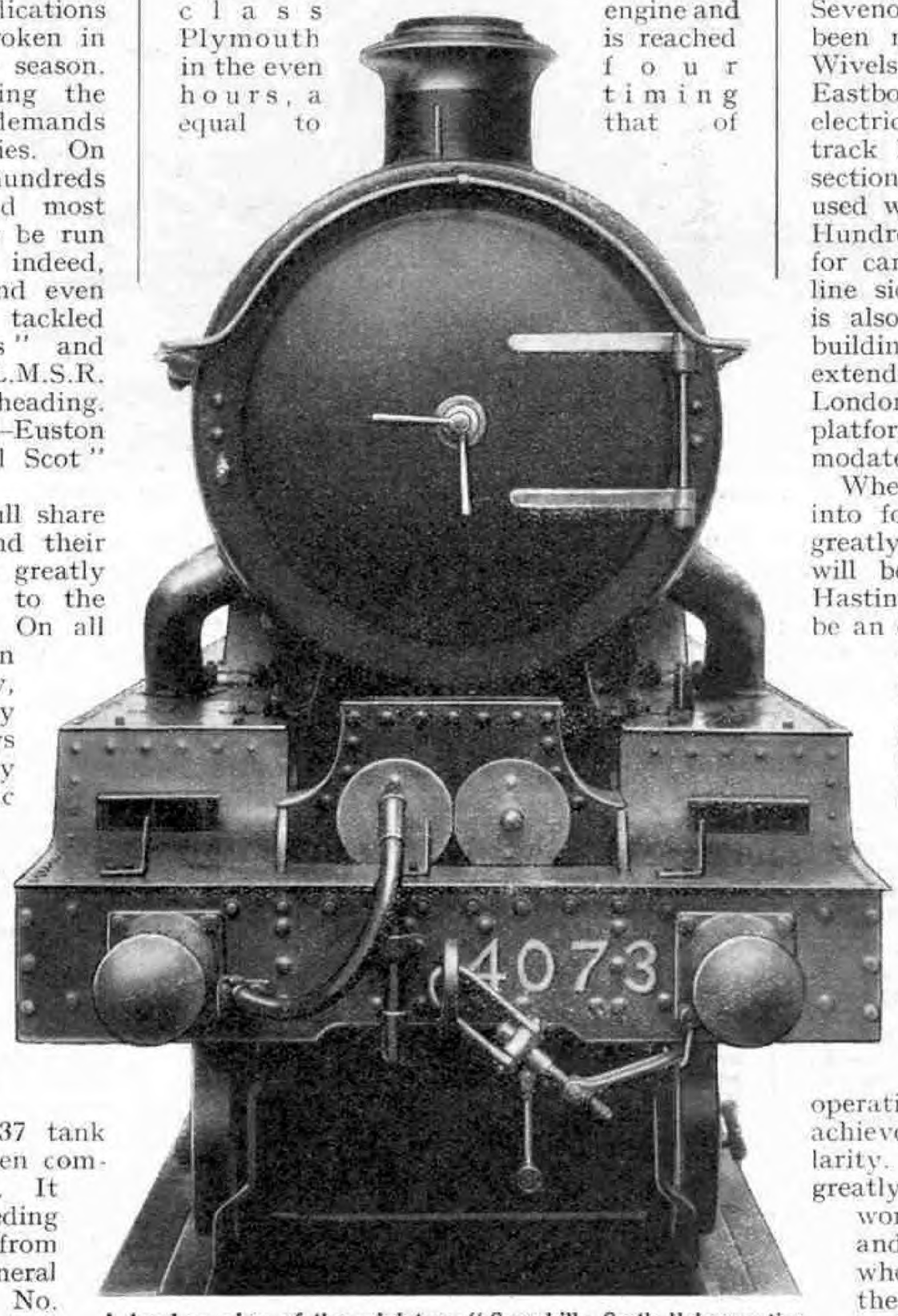
At the end of 1933 the L.M.S.R. had a total locomotive stock of 8,226, which comprised 5,582 tender locomotives, 33 "Garratts," 2,610 tank engines, and one heavy-oil shunting engine. The total a year before was 8,450.

The first of a new series of 37 tank engines of the 2–6–4 type has been completed at the works at Derby. It is numbered 2500 and succeeding engines will take the numbers from 2501 to 2536 inclusive. In its general design and chief dimensions No. 2500 is similar to the previous standard 2–6–4 tank engines of the L.M.S.R., but it embodies several interesting new features that are described in a special article that appears on page 390 of this issue.

Crewe works are engaged upon 10 standard 4–6–0 locomotives of the "Baby Scot" type, and these will be followed by five similar engines, but with taper boilers. The completion of the 10 engines with ordinary boilers will bring the total of the class to 52.

G.W.R. Fast Newspaper Express

The long non-stop run of 226 miles from London to Plymouth is now being done nightly by a newspaper express that leaves Paddington at 12.50 a.m. The train is drawn by a "King" class engine and is reached in the even Plymouth four hours, a timing equal to that of the fastest passenger expresses and requiring an average speed of 56.5 m.p.h. Between Plymouth and Penzance the train calls at the principal stations, from which branch line connections are run to enable all parts of Cornwall served by the G.W.R. to get the benefit of early newspapers. The through train arrives at Penzance at 8 a.m.



A head-on view of the miniature "Caerphilly Castle" locomotive described on page 392. The arrangement of the front end details is no less perfect than that of the rest of the engine, and enables the model to be recognised instantly as representing a G.W.R. prototype.

"Southern Electric" Progress

With characteristic vigour, the S.R are pushing forward the schemes for electrifying further portions of their line. Work is well in hand for extending the London suburban electrification to Sevenoaks, and considerable progress has been made in preparing the lines from Wivelsfield and Brighton to Seaford, Eastbourne, Bexhill and Hastings for electric traction. Extensive lengths of track have been relayed, and in certain sections where steel sleepers had been used wooden ones have been substituted. Hundreds of the white concrete posts for carrying the electric cables along the line side are already in position. Work is also proceeding on some of the new buildings that will be required and in extending some of the stations. At London Bridge, Lewes and Eastbourne, platforms are being lengthened to accommodate 12-coach trains.

When the new electric services come into force the number of trains will be greatly increased, and the running time will be reduced. Between London and Hastings, via Eastbourne, there will be an express every hour, with additional trains during business periods. The average time for the journey between London and Eastbourne will be shortened from 1 hr. 39 min. to 1 hr. 28 min., giving an acceleration of 11 min. For these expresses to and from London the latest corridor stock will be provided. Local services between Brighton and Lewes and Seaford, Eastbourne and Hastings will be much smarter and more frequent than at present.

The electric services between London and Brighton and Worthing, which have been in operation for well over a year, have achieved remarkable success and popularity. The number of passengers has greatly increased and the trains are working with noteworthy regularity and punctuality. A correspondent who travelled recently by one of the electric expresses from Victoria to Brighton reports that the running was extremely smooth and comfortable, and in spite of a signal check at South Croydon, Brighton was reached almost 4 min. early.

Petrol Electric Mobile Cranes for L.N.E.R.

The L.N.E.R. are introducing petrol electric mobile cranes for the rapid unloading of freight. Already 10 of their principal centres have been supplied with the new cranes, which can be moved along the freight trains on arrival.

Railway Camping Coaches

A novel form of holiday that should make a special appeal to railway enthusiasts is being provided this summer by the L.N.E.R. and the G.W.R. Both railways have had a number of coaches specially adapted for camping, and are placing them for the holiday season at various attractive centres in the North, East and West of England, Central Wales and the Cambrian Coast, and in Scotland, where they may be hired by campers at quite low charges. In all cases the coaches will be situated adjacent to a station. Each coach has two separate sleeping compartments together accommodating six people, a living room, and a kitchen. Supplies of blankets, sheets, pillows, crockery, cutlery and linen, as well as cooking stoves and all requisites, are included in each coach, clean linen from the railway laundries being supplied each week.

This "camping coach" scheme was tried with success by the L.N.E.R. last summer, and it is expected that it will be very popular this year. It certainly has great attractions, offering all the joys of camping without its inconveniences.

"The Northern Belle"

The L.N.E.R. have arranged for their luxury cruising train, "*The Northern Belle*," which might aptly be described as a hotel on wheels, to make four weekly cruises, starting from King's Cross at 9 p.m. on June 1st, 8th, 22nd and 29th. A very attractive itinerary has been mapped out, and each tour will cover 2,000 miles. In addition to travel by the train, trips will be made by motor cars and steamers, and thus in the course of a week many of the most beautiful parts of England and Scotland will be visited.

New "Schools" on the S.R.

Five new 3-cylinder 4-4-0 locomotives of the "Schools" class have been put into service on the Southern Railway. They were built at the works at Eastleigh and their numbers and names are: 920, "*Rugby*"; 921, "*Shrewsbury*"; 922, "*Marlborough*"; 923, "*Uppingham*"; and 924, "*Haileybury*." The first two are stationed at Ramsgate; the second two at St. Leonards; and the last, which has just completed its trials, is for the time being stationed at Nine Elms. There are now 25 of these locomotives in service, the first of the class being No. 900, "*Eton*."

Record Run by L.M.S. "Pacific"

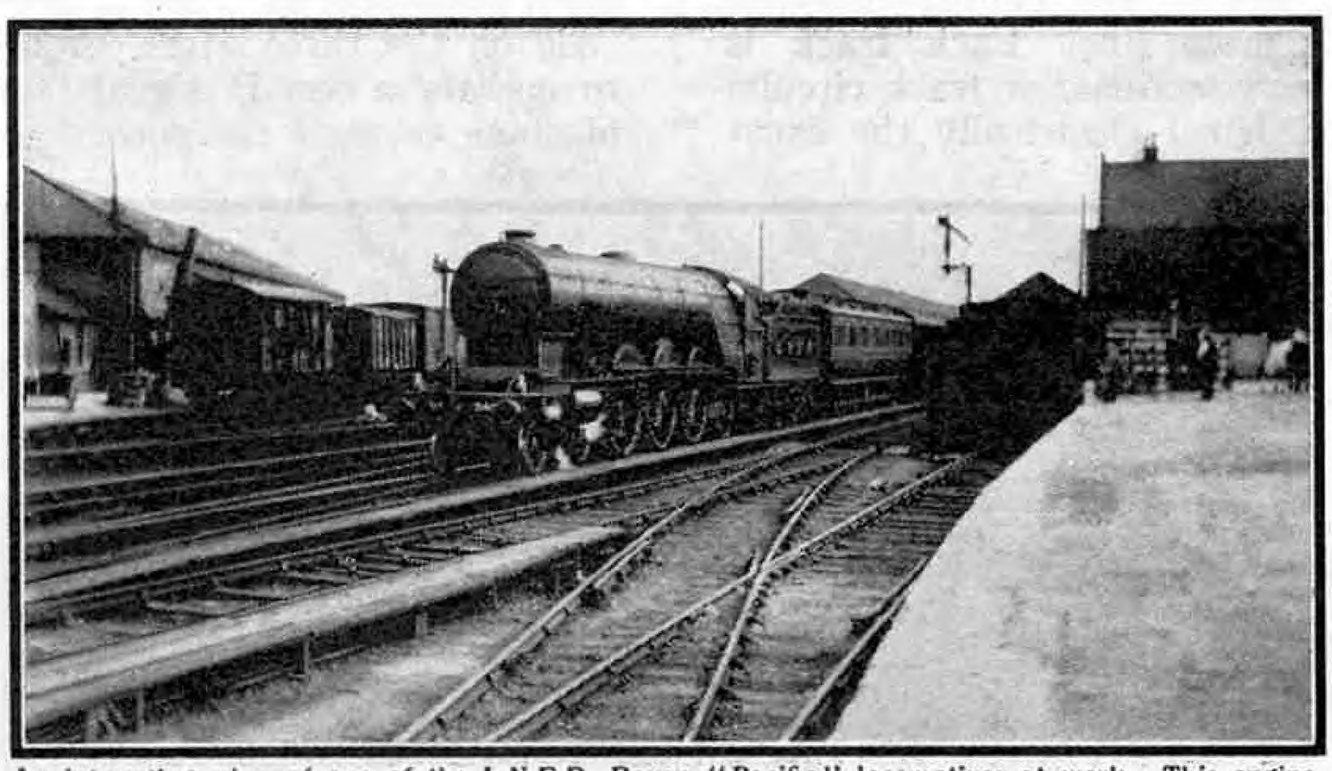
The desire expressed on page 290 of last month's "*M.M.*" that a "Pacific" might be tried on the hardest locomotive turn on the L.M.S.R.—that of taking the 10.30 a.m. express down from Euston to Liverpool and returning with the "*Liverpool Flyer*," leaving Liverpool at 5.25 p.m.—met with speedy fulfilment, for on Friday, 6th April, No. 6200 "*The Princess Royal*," was given that working, and, as was confidently expected, records were broken.

The down train consisted of 16 coaches (540 tons) but owing to a series of delays, the arrival at Crewe was 4 min. late. With the load reduced by more than half, Liverpool was reached 1 min. early.

On the return journey, 15 coaches weighing 475 tons were taken from Liverpool, but at Crewe three coaches were dropped, reducing the train to 380 tons. Willesden was reached in 7 min. 25 sec. less than the schedule allowance, the 152.7 miles from Crewe having been covered in 134 min. 35 sec., start to stop, or at an average speed of 68 m.p.h.



A Liverpool express to the North passing Ormskirk. The locomotive is one of the L.M.S.R. Horwich four-cylinder 4-6-0s, and is producing fine smoke and steam effects for the camera. Photograph by Mr. T. C. L. Hutchinson, Liverpool.



An interesting view of one of the L.N.E.R. Raven "Pacific" locomotives at work. This engine, No. 2404, "City of Ripon" was rebuilt some years ago with a Gresley pattern boiler. Photograph by J. W. Hague, Ripon.

Photographs of 30,000 Locomotives

Many readers of the "*M.M.*" are keen collectors of railway photographs, but it is doubtful whether any of them can equal the record of an employee of the Canadian National Railways who has collected over 30,000 photographs of railway engines. These represent the locomotives of nearly every railway in North America, and range from illustrations of the first steam-propelled vehicles to photographs of the latest railway "giants."

Electric Train-Indicator at Paddington

A new electric indicator, the first of its kind in the world, has been brought into use by the G.W.R. at Paddington Station.

It is 30 ft. long and 18 ft. high, and is conveniently situated near the subway to the Underground Railways on the big circulating area, from any part of which it can be seen. The case is built of polished teak and is divided into eight panels, each of which is set out to display the booked arrival time of a train; the platform into which it will run; the number of minutes late, if any, and a list of the stations at which the train has called.

The indicator is operated from an overhead control cabin, which is connected by telephone with the signal box on the arrival side of the station, and also with control points some miles down the line. The operator in charge sits at a desk in front of which is arranged a series of keys very like those of a typewriter, each of which is electrically connected to the mechanism in the interior of the indicator.

Every train has a special number. Information comes to hand from the control points of the passing time of a train, usually about 20 min. before it is due to arrive at Paddington, and this is electrically communicated to one of the panels when the appropriate key is depressed. When the number of the platform into which the train is to run is known, this is similarly recorded, and the operator is kept fully aware of what is being displayed by a miniature reproduction of the indicator board in the cabin.

One of the most wonderful features of the new indicator is the fact that the selection of the correct names for each train is automatic and takes place when the train's number key is depressed.

The new indicator is a British production. In its construction thirty-seven miles of wire were used and 190,000 joints made.

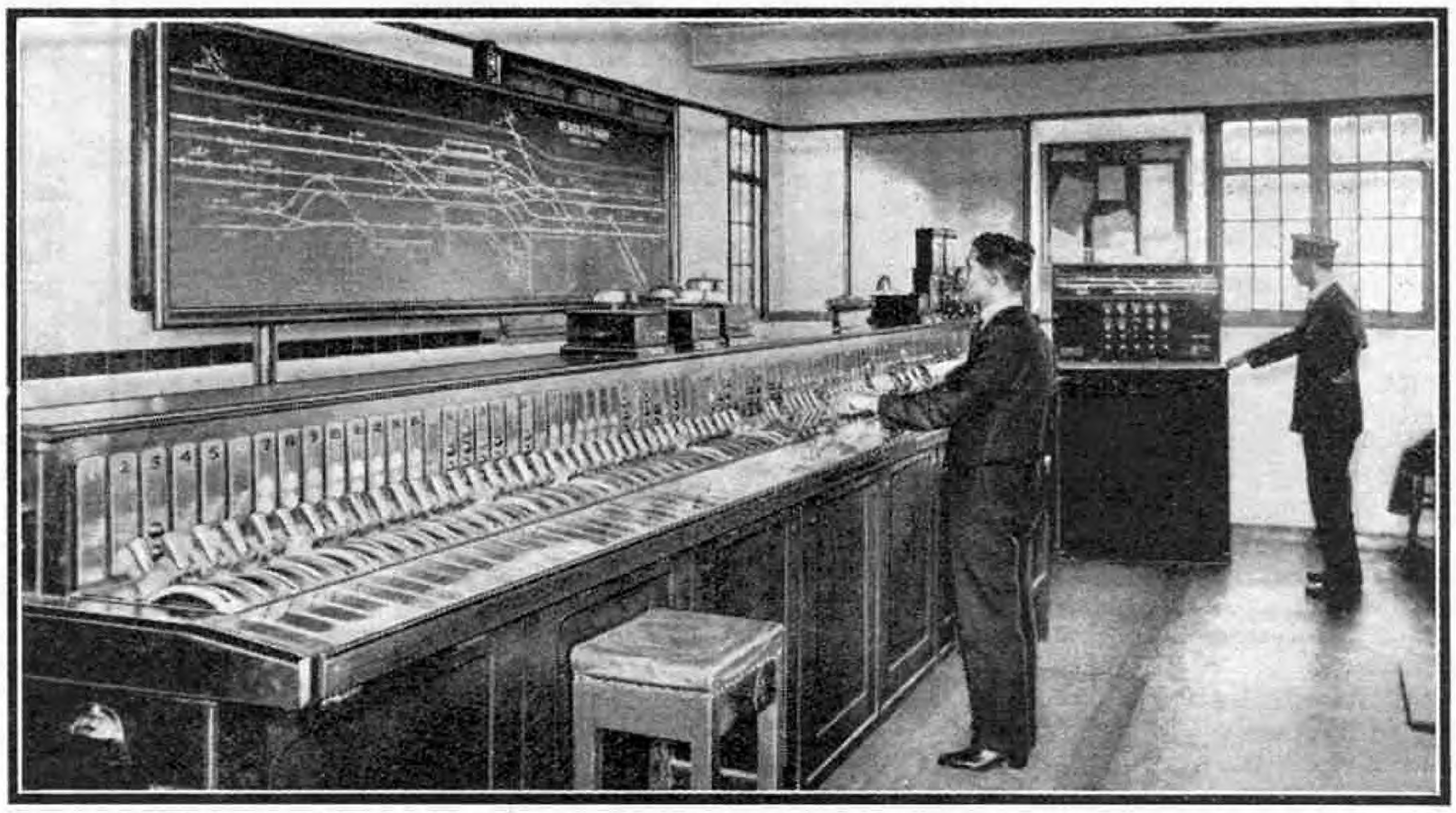
A Unique Signalling System

Centralised Control on the Metropolitan

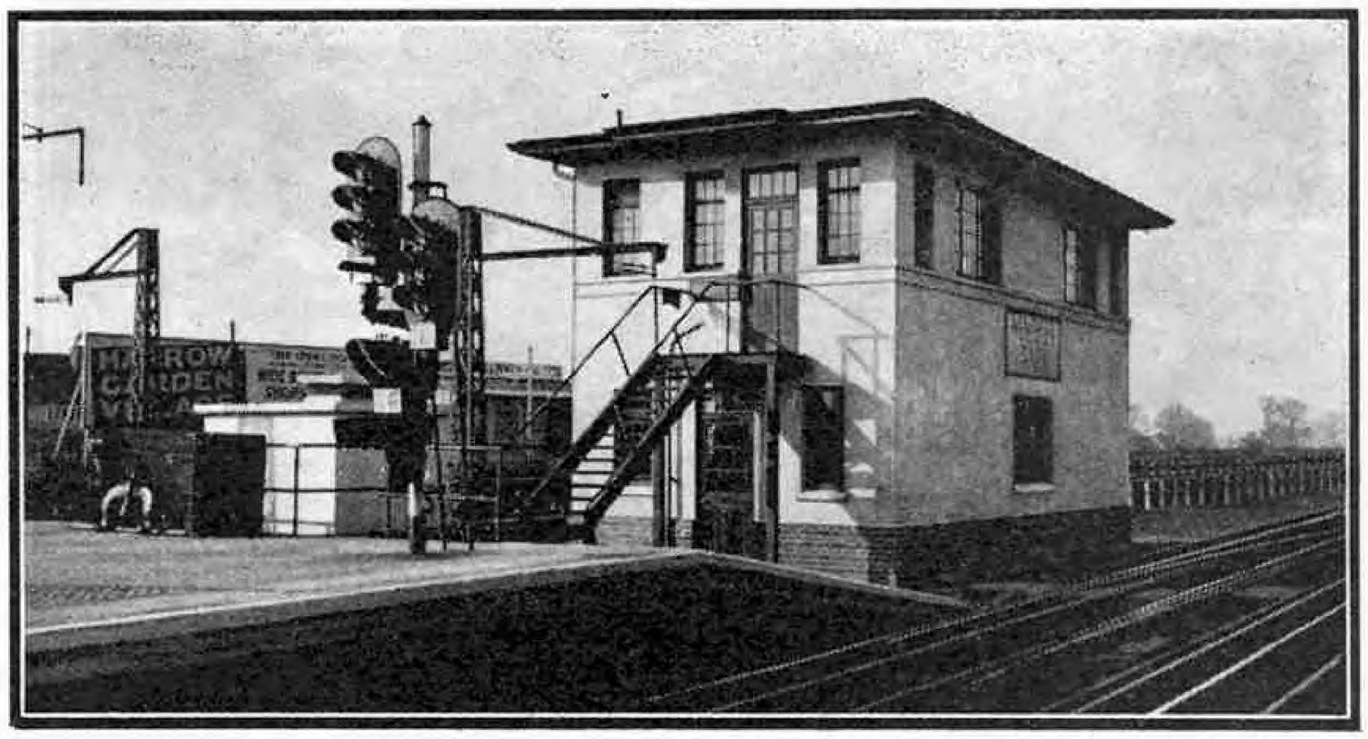
By a Signal Engineer

THE Metropolitan branch line to Stanmore, which was opened in December 1932, is unique among the railways of Europe. The branch leaves the main line of the Metropolitan at Wembley Park and is 4½ miles long. Throughout its whole length there is not one signal box, and Stanmore station, the terminus, is worked entirely without signalmen.

All traffic on the Stanmore line is controlled from the signal box at Wembley Park. Here is a steel cabinet shaped something like an upright piano, and on the front of this cabinet is a chart that shows in diagrammatic form all the points, crossings and signals on the Stanmore line. Each track is divided up into a number of sections, or track circuits as they are called, which detect electrically the exact position of all trains. Each of these sections has a corresponding lamp on the track diagram at Wembley, and the presence of a train in any particular section is shown to the signalman by that particular lamp going out. Below the chart are little thumb switches for working the points and signals, and just above each switch are tiny coloured lights that show whether the aspect of the signal is "Danger" or "Clear."



The interior of the signal-box at Wembley Park. The whole of traffic on the main line and on the Stanmore Branch is directed from this point. This and the upper illustration on the opposite page are reproduced by courtesy of the London Passenger Transport Board.



Another view of the Wembley Park box, and the three-aspect colour-light signal beside it.

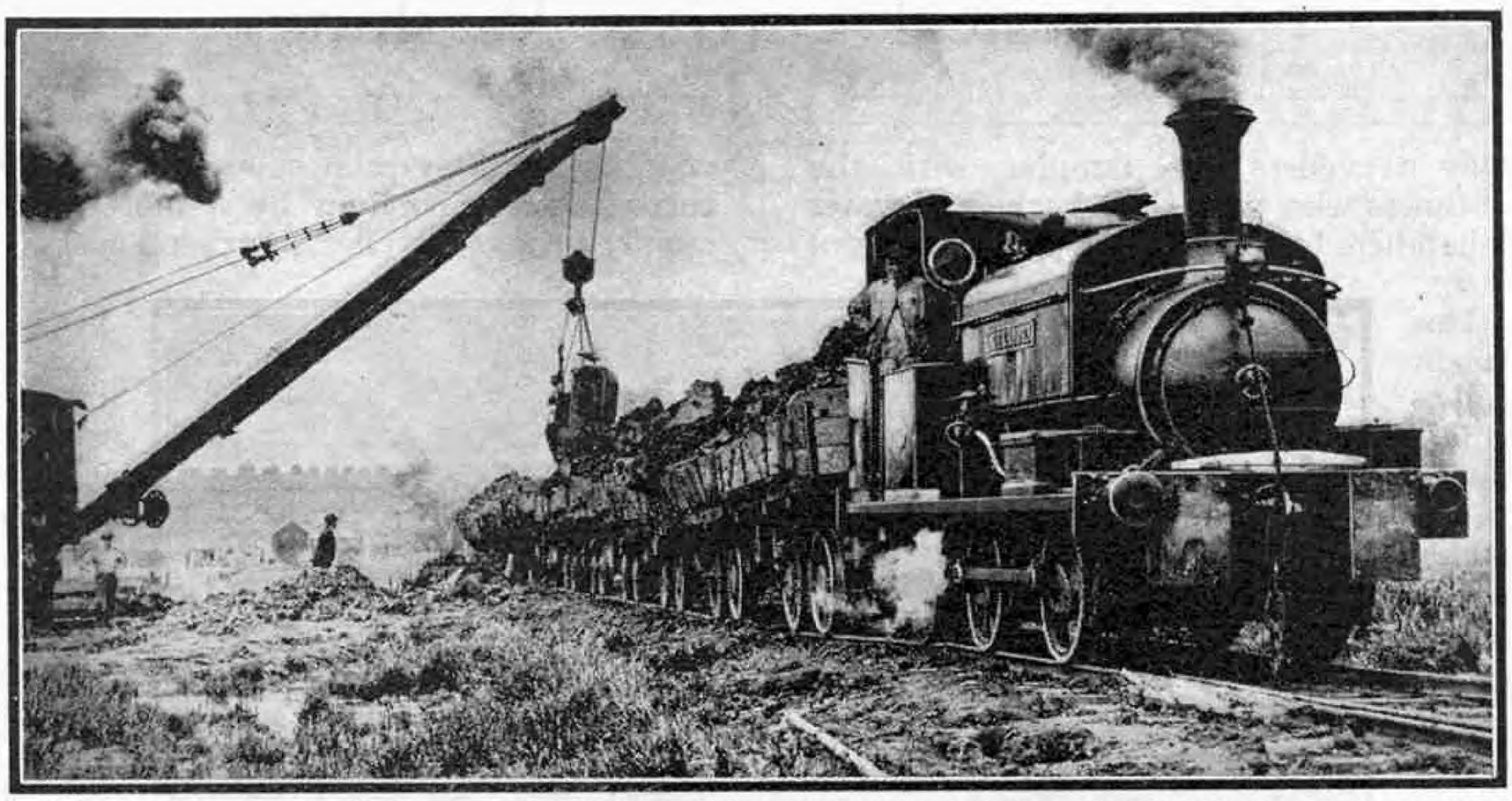
Now we come to the really novel feature of this system of signalling. Only three electric wires are needed between Wembley Park and Stanmore to control 10 pairs of points and as many signals; and the same three wires are used also to light all the indication lamps on the control cabinet at Wembley. With ordinary electric signalling two wires would be required for each signal, seven for each pair of points and one for each indication lamp.

When the signalman moves his thumb switch to operate a certain signal, current is applied to an instrument inside the control cabinet called a coding machine. This machine sends current to Stanmore in a series of short spells, like the dots and dashes of the Morse code; and by varying the number of spells on each of the three wires a large number of codes can be given. Each signal and each pair of points has its own particular code on the three wires. When the signalman wishes to operate a certain signal it is the job of the coding machine to send the correct code, and this it does in the same manner as an automatic telephone exchange gets the number that is dialled.

At Stanmore the code is received by a "storage" machine, which promptly applies power to the correct piece of apparatus. Then when the points have moved, or a signal has changed its indication, current is applied to a coding machine at Stanmore and this quickly makes up the correct code and sends the information back to Wembley, still on the same three wires. The Wembley storage machine receives the code and flashes up the information received on the signal box chart, and the signalman then knows that the apparatus has responded and all is well.

The apparatus works remarkably quickly. From the time when the signalman first moves his switch, until the confirmation is received that the points or signal have responded, is never more than 10 seconds.

It may happen that, just as the signalman desires to send out a code, a train is entering a new section, and therefore a code indicating this will be coming in just as another one is being sent out. It is not possible to have two codes on the three wires at the same time, so it is arranged to hold up the incoming code at Stanmore until the code sent out from Wembley is complete and confirmation has been sent back. Then Stanmore gets its turn and sends along its code.



An interesting view showing a typical construction train at work on the Stanmore Branch. The locomotive is a sturdy six-coupled saddle tank, and the wagons are of the usual side-tipping variety.

At busy times the signalman may wish to make two moves in such rapid succession that he cannot wait for the indication of the first to be received before he sends out the second. Then the instruments so arrange matters that the returning code is held up until the signalman has finished, and then the indication of both movements are sent through, one after the other.

The main line signals are of the three-aspect colour-light type, and for shunting small disc type ground signals are used. The electric point machines contain a mechanism that not only moves the points, but at the same time detects electrically that they are properly closed after moving.

The machines at Stanmore are of a specially powerful type that can operate both ends of a crossover. To reduce the load on the point machine the switches are of a novel type running on roller bearings. As on the Underground railways, electrically-operated train stops are provided that make it impossible for a driver to pass a signal that is at "Danger."



The view from the end of the station platform at Stanmore. Here trains arrive and depart without a signalman being on the spot, for all operations are controlled from Wembley Park.

Stanmore has already become a very busy little station and there is something quite uncanny about the way in which trains arrive and depart without any signalman to preside over their movements. Everything that happens, however, is faithfully recorded on the chart at Wembley. This wonderful system of traffic control surely has a great future. By controlling train movements in a large area from one central point the signalman can see at a glance exactly what is happening and can anticipate and avoid delays.

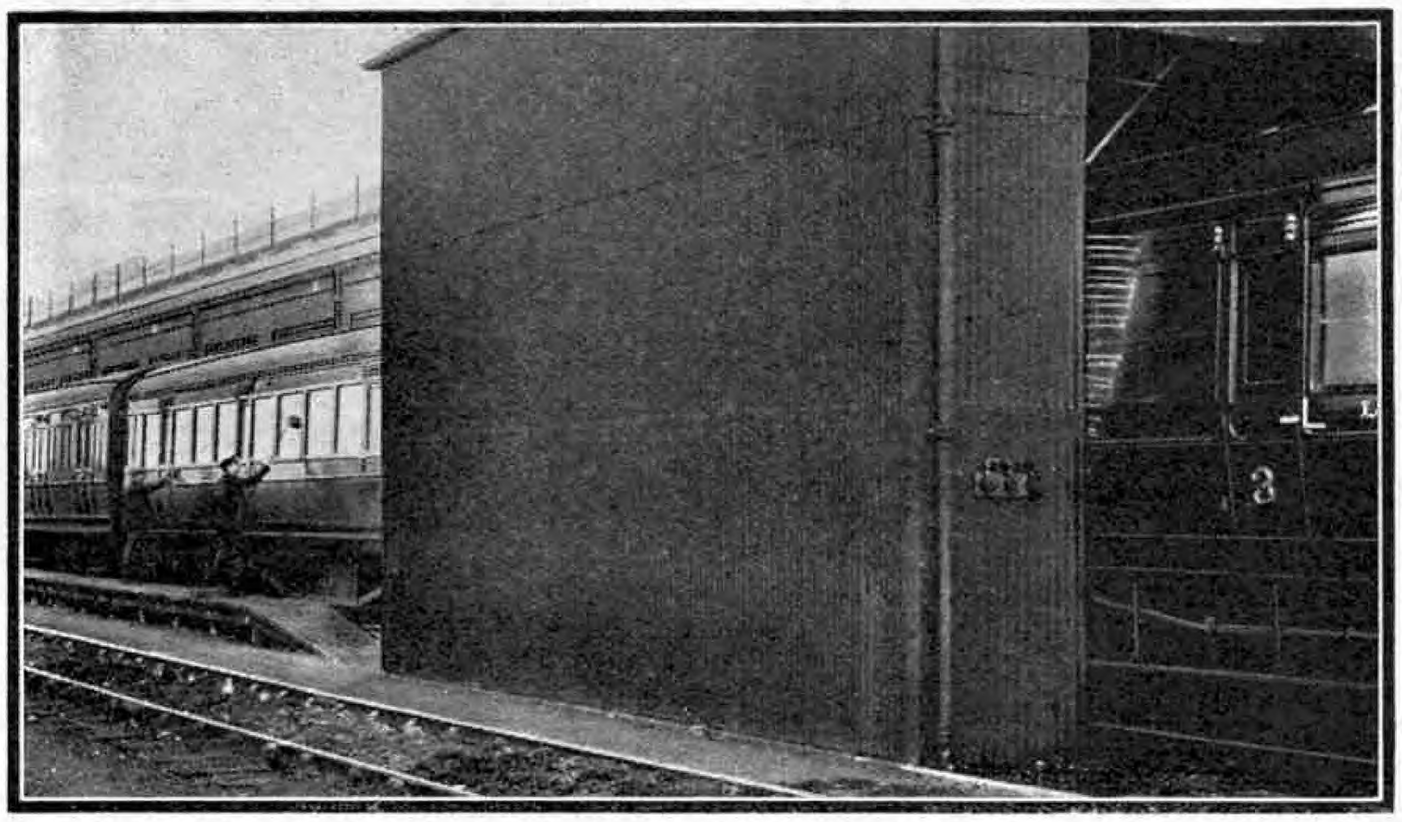
The Stanmore Branch leaves the main tracks between Wembley Park and Preston Road, and strikes boldly across country through Kingsbury and Queensbury, also serving the Canons Park district of Edgware. Parliamentary powers were obtained in 1930, and the construction of the line was immediately put in hand. Over half-a-million cubic yards of earth had to be removed, and one of the chief difficulties was the task of diverting Wealdstone Brook, a swiftly flowing stream that crossed the route no less than five times. Concrete channels and large culverts had to be constructed, and six important bridges were necessary. In the erection of these bridges the most modern methods were employed. The use of brick facing, with heavy concrete backing saved a considerable amount of labour.

There is a great deal of romance attached to Stanmore and its immediate surroundings. The defeat of the Romans in a battle fought there with the British chief Cassivelaunus is recorded on an obelisk erected on the approximate site on top of Stanmore Hill. The Roman occupation of Verulamium, or St. Albans, resulted in a strong camp being established on this hill to guard Watling Street. A rampart and fosse are still to be seen and many Roman relics have been discovered on the site of the mediæval priory of Bentley, near Stanmore. The Domesday Book of William the Conqueror mentions both Great and Little Stanmore.

Shower Baths for Railway Coaches

Mechanical Carriage Washing

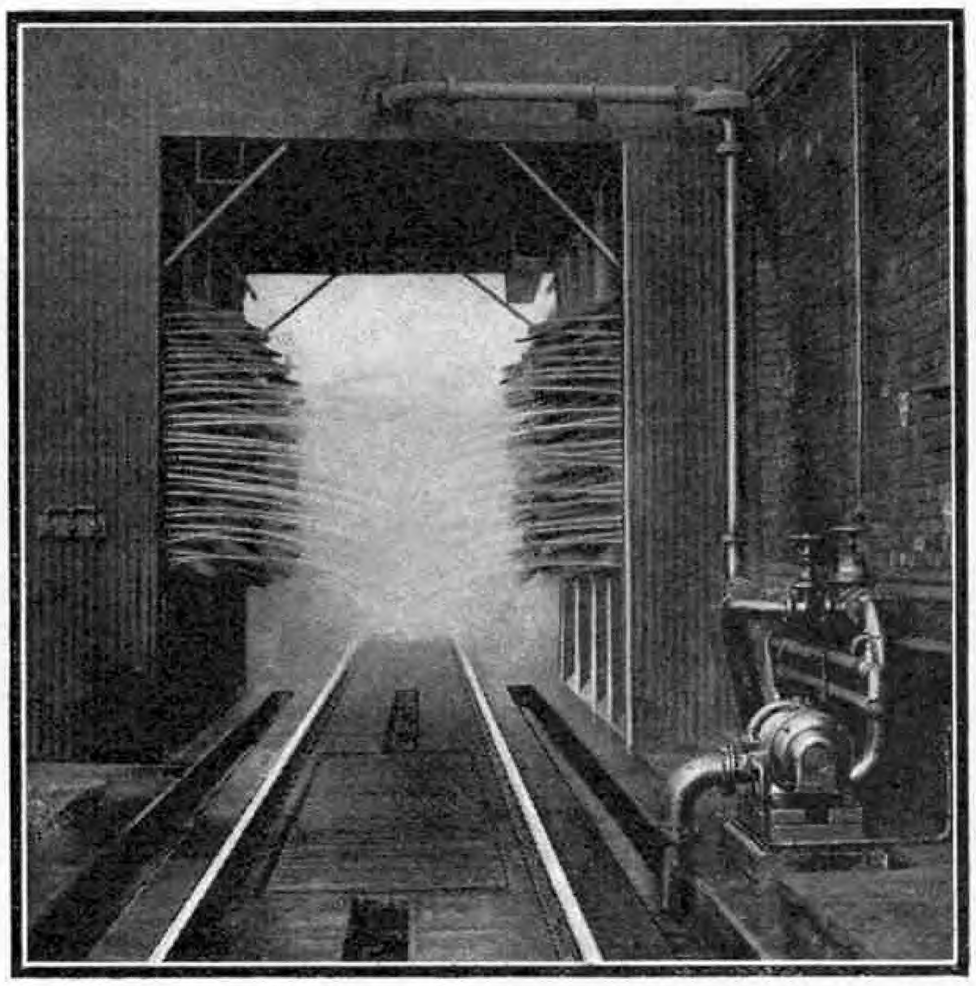
MOST railway travellers are familiar with the carriage cleaners who, with their buckets of water and long-handled brushes, remove the grime of travel from the exterior of trains. This method of treatment is effective enough as far as it goes, but it is necessarily slow if the work is to be done with reasonable thoroughness. Where large numbers of coaches have to be dealt with in a limited time the expense involved in washing by hand is liable to be very considerable. Modern mechanical methods have now been applied to the simple operation of washing down the sides of vehicles, and carriage-washing machines are installed at various points by the L.M.S.R., the L.N.E.R. and other companies.



A carriage washing plant in action showing the jets of water being projected against the coach side. The photographs on this page are reproduced by courtesy of the L.M.S.R.

Machines of this type were already in use at Bercy on the P.L.M. system of France, and at Pittsburgh on the Baltimore and Ohio Railroad in the United States, when the L.N.E.R. decided to instal plants at nine different points along their system. The Ealing Common Depot of the London Underground Companies was also equipped with one of these installations. The scheme has been adopted more recently by the L.M.S.R., and the photographs on this page show a plant of this company at Cricklewood that is capable of dealing with an average of 172 vehicles per day and more than 1,000 per week.

This installation incorporates four "drums" or wipers, two on each side of the track, formed of cloth or felt strips. These are secured to canvas holders suitably attached to vertical shafts that rotate at about 50 r.p.m. As the shafts rotate, driven by a 20 h.p. motor through a belt and bevel gearing, the cloth strips are whirled round, and thus impinge on the sides of the coaches. Water is fed to the wipers by a perforated pipe above the drums, and there are also vertical spray pipes to rinse the coach sides after each shower. The water is pumped through the pipe lines by a motor-driven pump, the supply being controlled by a stop cock. A final rinsing of clean water is projected against the coach sides, and the dirty water runs away through a large sump and filters.



A wet journey ahead ! A view through a carriage washing plant showing the wipers being rotated while water is fed to them by a motor driven pump.

The L.N.E.R. plants are similar, but they differ in detail. Four drums are arranged on each side of the track, belt and bevel-driven as before, making a total of eight drums, and the arrangement is such that the various drums revolve in different directions at different speeds. The first makes 40 r.p.m., the second 46, the third 59, and the fourth 37, and owing to their positions relative to the perpendicular pipes for spraying the carriages, these are first washed, then rubbed and washed alternately by each set of wiper drums and pipes, and finally rinsed with clear water.

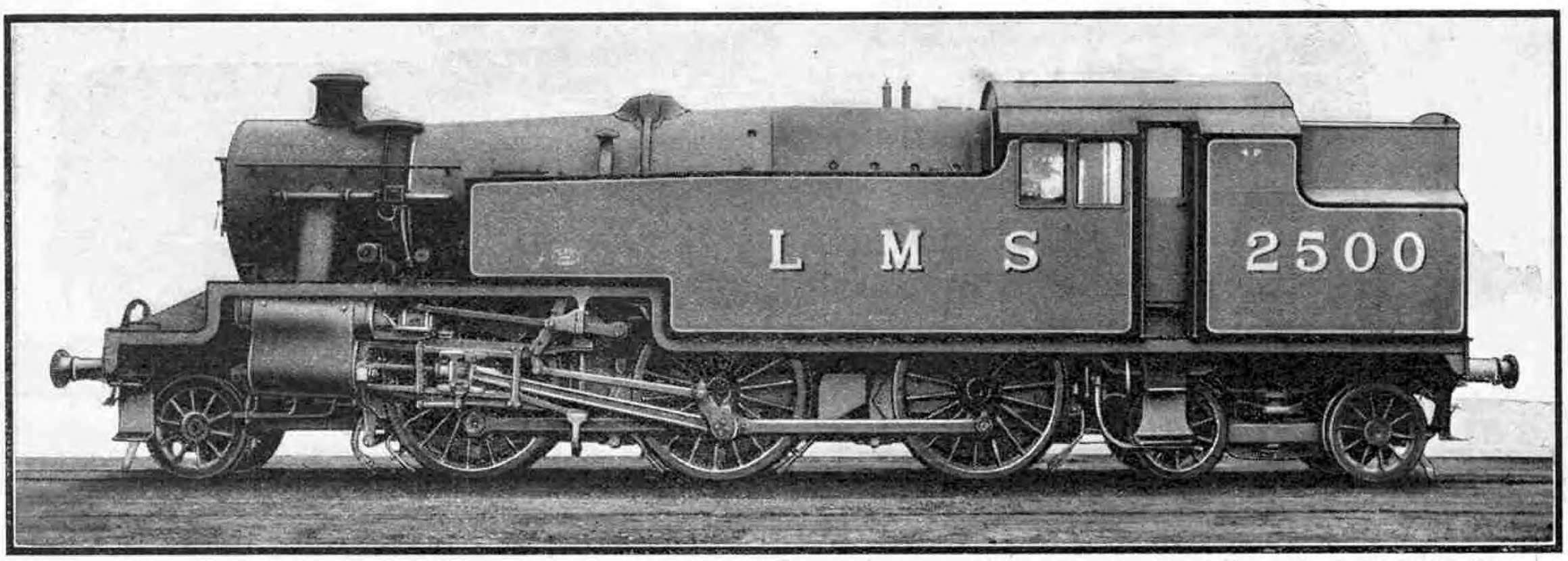
The results are very satisfactory. No chemicals are used, except for carriages that run a great deal in tunnel service, which have to be smeared with a little acid cleaner before entering the plant. No wiping down is done, the water drying off, so that the ends and door handles alone remain to be cleaned by hand. A train of 12 vehicles can be washed in about six minutes with this type of plant.

The nine L.N.E.R. installations are distributed in the following manner:—Southern area, at Marylebone, Ilford and Hornsea; North Eastern area, at York, Heaton and South Gosforth; Scottish area, at Craigentinny, Cowlairs and Bridgeton Cross. All these are important centres dealing with large numbers of vehicles, so that the economy and efficiency of the mechanical washing system is utilised to the fullest advantage.

On the Southern Railway there is an extensive installation at Brighton for cleaning the electric trains, which includes a carriage-washing plant.

New Locomotives for the L.M.S.R.

Three-Cylinder Tank Design



FOLLOWING on the completion of the series of standard 2-6-4 tank locomotives, the later members of which are provided with enclosed side-window cabs, a three-cylinder version of the same general design has been produced by the L.M.S.R. In the photograph on this page it will be seen that various other modifications have been made, apart from the application of three-cylinder propulsion. These are notably in the provision of a tapered domeless boiler and many other features that have characterised the "Pacifics" and new "Moguls" built to the designs of the present Chief Mechanical Engineer, Mr. W. A. Stanier.

Thirty-seven of these new engines are being built, and they will bear the numbers 2500–2536, the first of them being shown in the illustration. It is intended to employ this type of locomotive on the residential expresses between London and Southend-on-Sea when engineering works that are now in progress have been completed. On these services they will be able to display to the full the rapid acceleration characteristic of three-cylinder simple engines, which quality indeed has been a reason for the adoption of this type. Like the new "Mogul" tender engines described on page 213 of the March issue of the *"M.M.,"* these new tank engines are built on powerful and up-to-date lines, and have a very solid appearance.

The three cylinders are each 16 in. in diameter, with a piston stroke of 26 in. A separate set of Walschaerts valve gear governs the distribution of steam to each cylinder, as in other L.M.S.R. three-cylinder types, the primary motion for the inside gear being obtained from an eccentric on the driving axle. Double slide-bars are used for the outside cylinders, but a single bar for the inside cylinder, which is more inclined than the outside ones, in order to clear the leading coupled axle and to accommodate the inside valve gear. Movement is imparted to the wheels by means of connecting and coupling rods of high tensile manganese molybdenum steel, which is used also for the valve gear. The connecting rods are of fluted section, but the coupling rods are not.

All wheels are of similar design and construction to those of the "Pacifics" and the new "Moguls," being steel castings with rims of triangular section. The coupled wheels are 5 ft. 9 in. in diameter, and have built-up balance weights attached. The leading wheels run in a Bissel truck, and both this and the trailing bogie take the weight through side bolsters, and have side check spring gear of a flexible type to ensure smooth riding at speed.

The tapered boiler carries a pressure of 200 lb. per sq. in., and is domeless, the main regulator being incorporated in the superheater header in the smoke-box. The dome-shaped cover on the boiler barrel accommodates the top feed valves, through which water is introduced to the boiler. A moderate degree of superheat is aimed at, and the general arrangements of the boiler correspond with Mr. Stanier's previous practice in these matters, the steam supply for the boiler auxiliaries being taken from a manifold with a main shut-off valve on top of the fire-box door plate.

Mechanical sanding apparatus is provided, sand being led to the front of the leading and centre pairs of driving wheels, and to the rear of the latter also. In addition a hot water de-sanding apparatus is fitted that automatically removes sand after the driving wheels have passed over it, either in forward or reverse direction, thus cleaning the rails and preventing interference with track circuits.

The cab is of the completely enclosed variety, having two sliding windows on each side, a drop window in each door, and hinged look-out windows in the front and back plates. Tip-up seats are fitted on each side of the cab, and a new feature is the arrangement of the coal bunker so that a clear look-out is afforded when the engine is running in a backward direction. The sides of the bunker are lower than on the two-cylinder 2-6-4 tanks, but the centre portion, as shown in the photograph, is raised up between the rear cab windows. The space between the outer sides and the raised portion is covered in, so that the backward view cannot be obscured by piled-up coal. Water scoops for operating in each direction, which are a feature of the two-cylinder engines, are not provided in the new locomotives, and the pump for maintaining the vacuum while running is not fitted outside as on several previous L.M.S.R. designs, but between the frames. When the engine is standing, the small ejector maintains the vacuum on the engine and train. A steam brake is fitted to the coupled wheels of the engine and is controlled by the driver's vacuum brake valve. A hand brake is also provided.

Lubrication of the piston valves and cylinders, piston rod packings, and valve spindle bushes is effected mechanically, and a separate mechanical lubricator supplies the coupled axle-boxes.

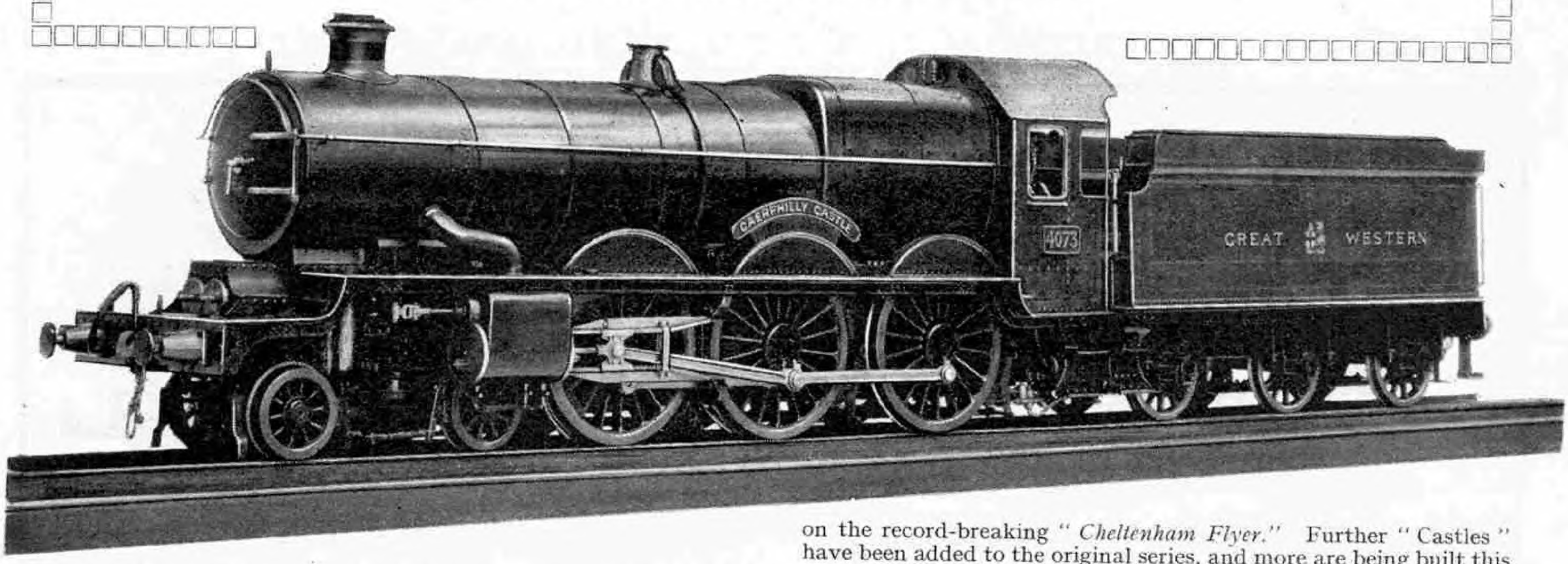
For the illustration on this page, and details regarding these new engines, we are indebted to the L.M.S.R.

Dimensions of New L.M.S.R. 2-6-4 Tank Locomotives

Cylinders (3)	
Diameter	16 in.
Stroke	26 in.
Wheels	
Leading	3 ft. 3½ in.
Driving	5 ft. 9 in.
Bogie	3 ft. 3½ in.
Heating Surface	
Tubes	1,011 sq. ft.
Fire-box	137 sq. ft.
Superheater	160 sq. ft.
Grate Area	25 sq. ft.
Working Pressure ...	200 lb. per sq. in.
Tractive Effort at 85 per cent. working pressure ...	24,600 lb.
Adhesive Weight	57 tons
Total Weight of Engine in working order	92 tons 5 cwt.
Coal Capacity	3½ tons
Water Capacity	2,000 gallons
Total Length over Buffers	47 ft. 2¾ ins.

"Caerphilly Castle" in Miniature

A Remarkable Scale Model

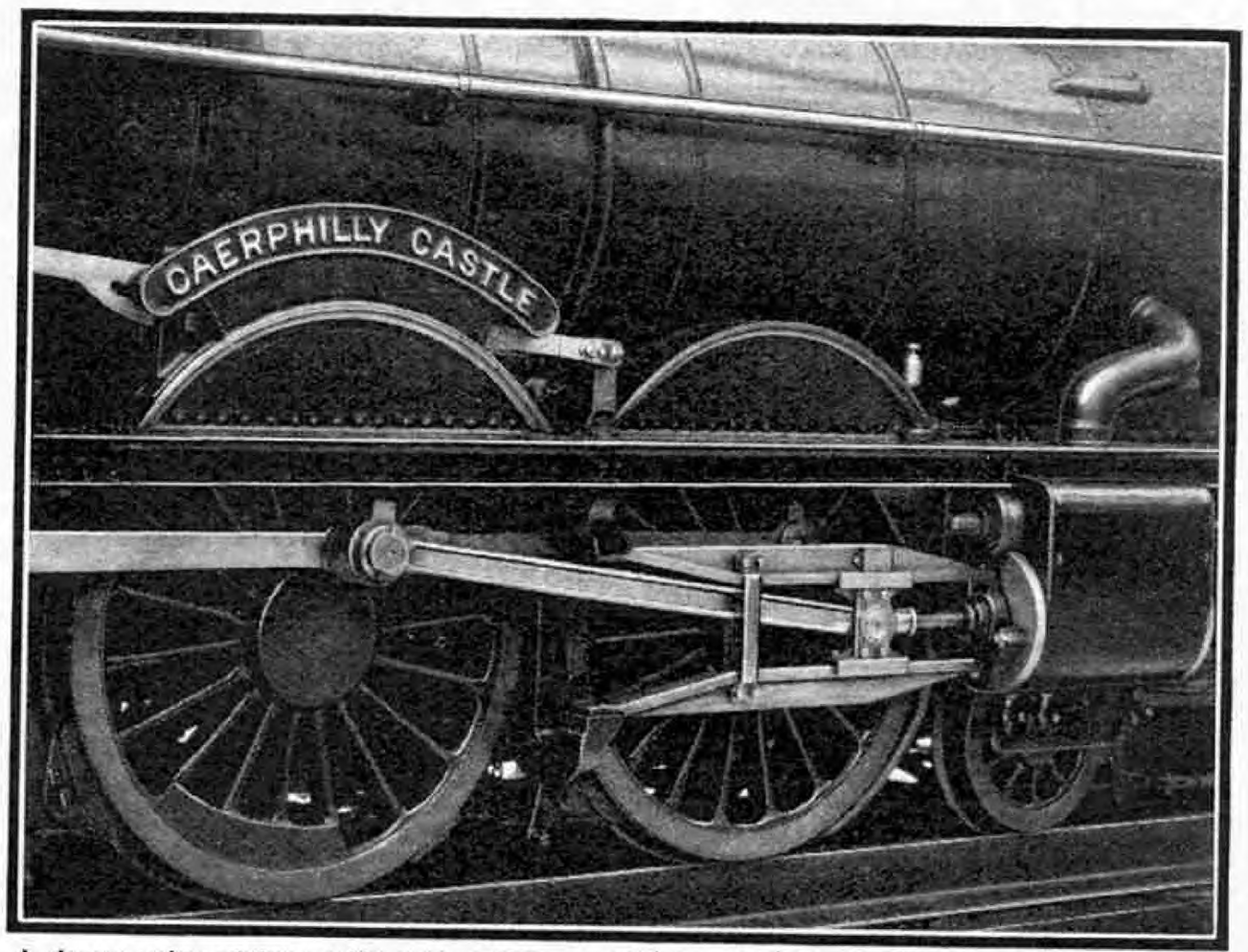


THE art of model-building has existed from very early times and, to judge from the few perfect examples that have been preserved to us, the craftsman of ancient Egyptian, or even more remote times, seems to have been filled with the same enthusiasm for his work as the model-builder of to-day. It is the fascination of perfect workmanship that impels the model-builder to labour at whatever piece of work he has in hand until it is complete in every detail. Time counts as nothing; he is prepared to devote his spare moments for weeks, months, or even years, to the completion of one particular model—and then immediately he starts another.

It is this type of enthusiasm that has inspired the construction of the miniature G.W.R. "Castle" class locomotive described and illustrated in this article. This model is the work of Mr. J. A. Nicholas, of Birkenhead, ably assisted by his two sons William and John. He has carefully followed the prototype throughout, and has reproduced almost every detail to the scale of 1 in. to the foot. It is interesting to note that Swindon drawings were made use of, with the result that the engine is to a remarkable degree a close reproduction of the actual thing. As the engine is intended for serious work, certain proportions and ratios have had to be modified; but this has not in any way affected the external appearance of the locomotive or tender.

Mr. Nicholas is a keen admirer of G.W.R. practice, which is not surprising in view of the fact that his grandfather worked under the famous engineer of that line, Isambard Kingdom Brunel. The regularity of the running for the past 25 years of G.W.R. four-cylinder engines on the famous "*Cornish Riviera Express*" so appealed to his imagination that it caused him to adopt one of these engines as the prototype for his model. In 1926 when the work was commenced the "Castle" 4–6–0s were the premier express engines, and naturally one of these was selected for reproduction. Since then the magnificent "Kings" have appeared, but the "Castles" have won renewed fame as a result of their exploits on the record-breaking "*Cheltenham Flyer.*" Further "Castles" have been added to the original series, and more are being built this year. No. 4073, "*Caerphilly Castle,*" the engine modelled, was the first one built, and is interesting also in that it was exhibited at the British Empire Exhibition at Wembley in 1924.

In building the engine the aim of the maker was not only to produce a close replica of the original, but also to make and machine as many of the various parts as possible in the same manner as in the prototype. To take just one example, the crank-axle is an exact copy of the built-up balanced crank-axle fitted to the real "Castles," but first provided on the immediately preceding "Abbeys." It was therefore assembled in separate pieces, the webs being shrunk on to the crank-pins, the journals and centre portion of the axle, and finally secured by keys. The complete crank was machined all over, no surface being hand finished, and it represents a very fine piece of work.

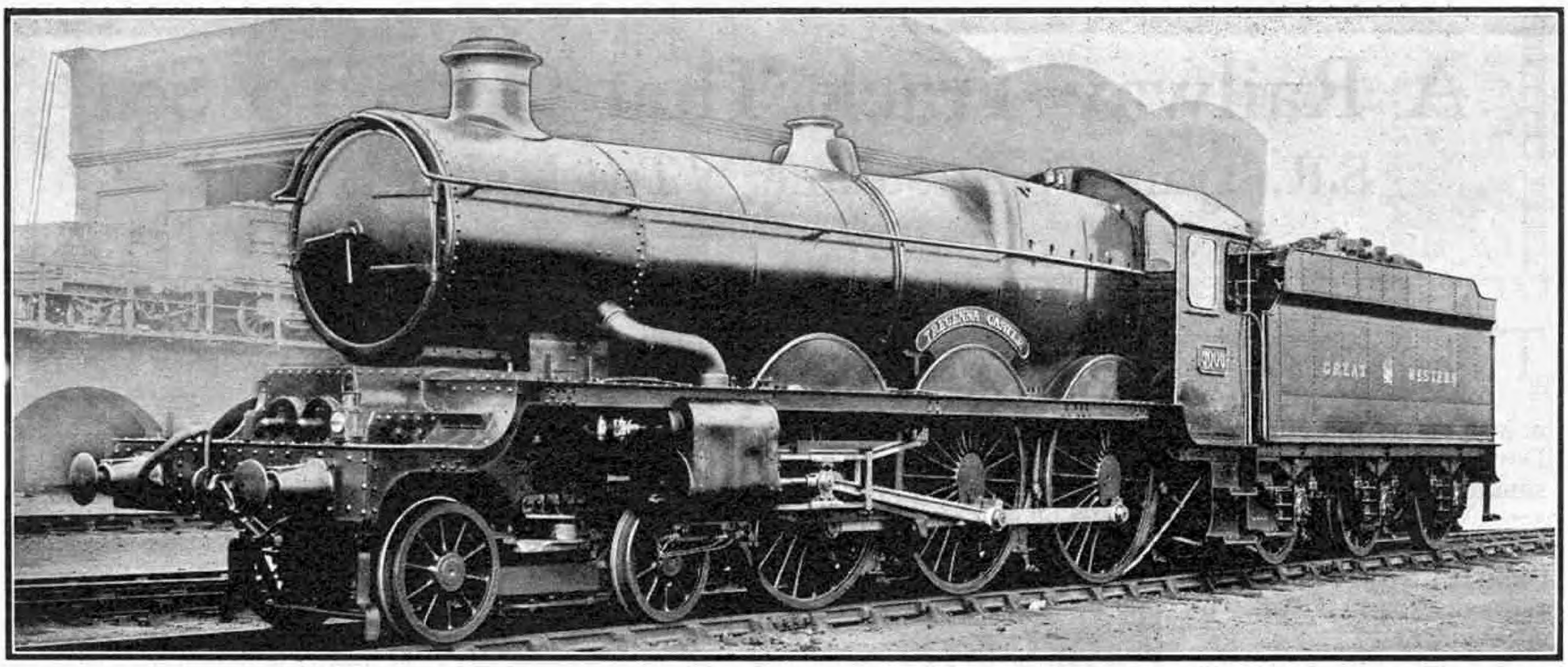


A close-up view of the outside motion of the model "Caerphilly Casile" locomotive. Characteristic features of Swindon practice are reproduced, as can be seen by the various details in this photograph.

A particularly interesting point is that, in addition to the making of the patterns for all the cast parts—in itself no small job—all the actual casting was done at home with the aid of a small brazing hearth. Some of the patterns, instead of being wood as is usual, were made of red fibre; an instance being the pattern for the bogie wheels, where the formation of the spokes in wood might have been a difficulty. All the patterns themselves are excellent pieces of work, and are an indication of the thoroughness with which the whole engine has been constructed. It is interesting that the cylinder castings were made solid, not cored out, in order to avoid the risk of blow-holes in vital spots.

All the forgings were made at home for such parts as the connecting rods and the slide bars. Thus Mr. Nicholas not only acted as moulder and foundryman, but also undertook different varieties of smithing, in addition to the work of designing, marking out, turning, fitting and erecting that was involved. The coupling and connecting rods and slide bars, as the illustrations show, are of the correct and characteristic G.W.R. outline and section.

It will be realised that this locomotive has involved a great deal of work not usually tackled by the model engineer, and the methods used in many cases were equally out of the ordinary. The main

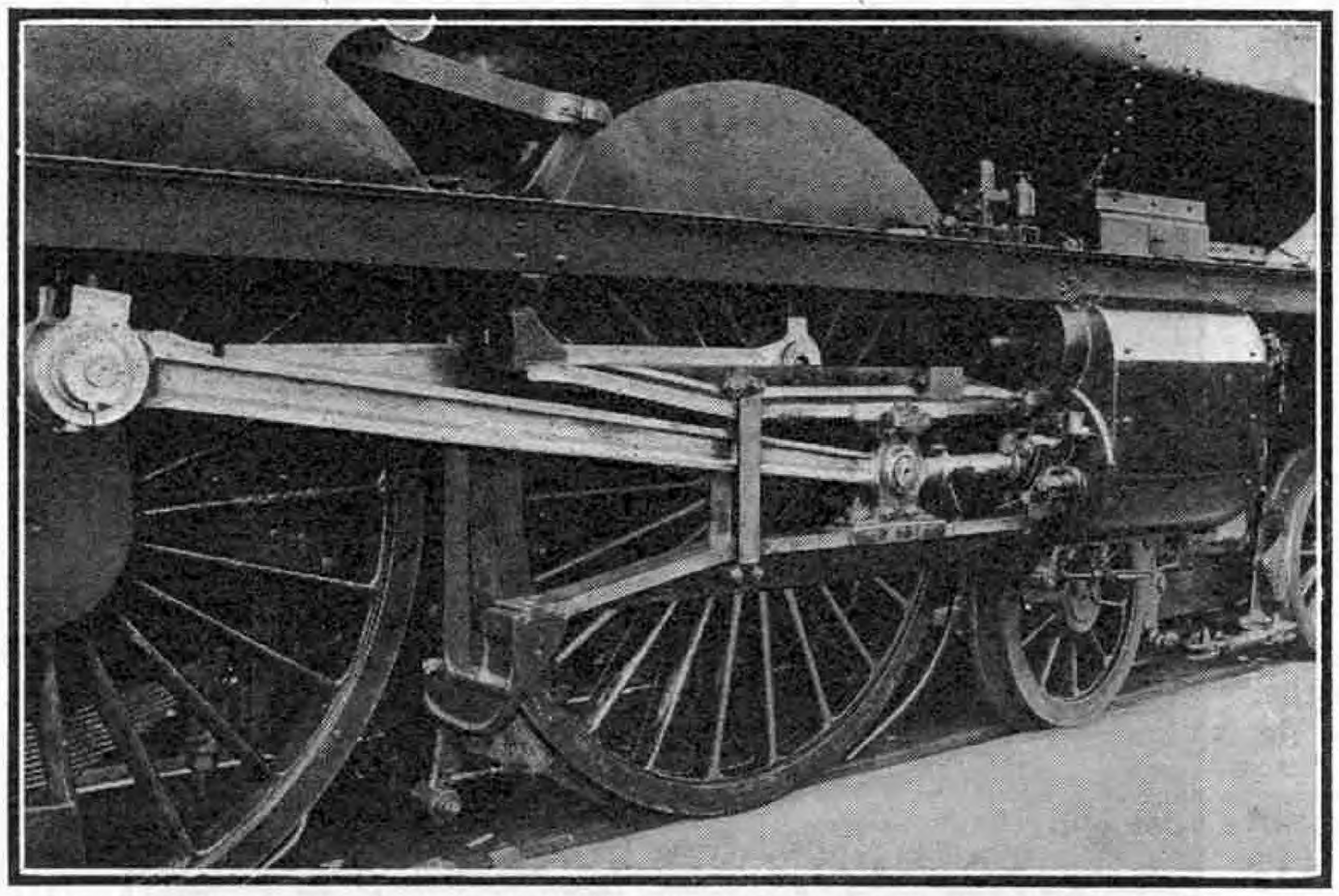


frames are of steel, and are correctly riveted and braced together as in actual practice, forming a strong foundation for the locomotive, as is vitally necessary in an engine weighing empty 1 cwt. 3 qr. 8 lb. with its tender, and able to pull some three quarters of a ton. All the parts of the real engine that are bolted together have been made so in the model, so that the engine may be taken to pieces if required in the same manner as the actual thing. The layout of the four cylinders exactly follows Swindon practice, and the inside cylinder unit forms an excellent frame stay at the front end. Incidentally, as may be noticed in the photograph on the opposite page, the main frames are set in immediately behind the leading bogie wheels in order to clear the latter on curves. This arrangement is found on the earlier examples of the real " Castle " class, and is another instance of the maker's attention to constructional detail.

The inside cylinders drive on to the crank-axle of the leading driving wheels, and the outside pair are connected to the crank-pins of the second pair of driving wheels. In connection with the cylinders it may be mentioned that the pistons are fitted with actual piston rings to ensure steam tightness, and do not rely on the ordinary methods of packing usually adopted for the pistons of miniature locomotives. These piston rings are of cast iron, turned, split and ground. Details of the outside motion are apparent in the close-up photograph showing these parts. This illustrates how closely the cylinders, rods and other details follow those of the prototype.

The inside motion of the engine is no less complete, for the full Walschaerts valve gear of the original is correctly reproduced, the eccentrics being placed between the inside webs of the crank-axle. The expansion links and the reversing shaft are supported by a special casting between the frames, as in the real engine. Some exceedingly close work has been put in here, yet the efficiency of the gear is such that the engine can be notched up to a very fine point of cut off. In actual practice these engines start off with the valves cutting off at about 75 per cent. of the stroke. As speed increases they are notched up until the cut off is about 13 per cent. of the piston stroke.

The perfect proportions of the valve gear parts in the model are shown audibly by the splendid and typically " Great Western " beat of the exhaust. The same strong, regular and clear-cut exhausts as in the real " Castles " issue from the copper-capped chimney when the model is on the move. The inside valves are operated direct from the valve gear, but there is of course the usual G.W.R. rocking lever arrangement for the operation of the outside valves. The connection of the outside valve spindle with the rocking levers is effected in the correct manner, the little forked and slotted rockers for this purpose being beautifully made. All bearings, however small, are lined with gunmetal or white metal bushes, and the slippers or bearing surfaces of the cross-heads are also correctly faced with white metal.



In the upper photograph is G.W.R. No. 5006 " Tregenna Castle," a famous member of the " Castle " class. The lower view is of the cylinders and outside motion common to G.W.R. four-cylinder engines.

The connecting rods are correctly milled to the appropriate section, which results in their being light yet strong. The driving wheels are forced on to the axles, and for additional security keys are inserted. The crank-pins of the driving wheels are connected by coupling rods, which of course are jointed to allow of the relative up and down movement of the axle boxes. Unlike the axle boxes of most miniature locomotives, which consist practically of a block of metal through which the axle passes, these provide a " top half " bearing only, as in real practice. The bottom half of each box contains an oil well and a felt pad for the lubrication of the journal.

The axle boxes slide in proper horn blocks riveted to the frames, and real working laminated springs govern their movement. These driving wheel springs are connected by compensating levers, an arrangement long popular on the G.W.R. The making of such springs in miniature calls for great delicacy of workmanship, for each spring plate or leaf has to be made and set separately, yet the complete springs must match each other perfectly or the weight of the engine will be unevenly distributed. The spring suspension rods on both engine and tender are adjustable by means of lock-nuts. At each end of the spring system of the coupled wheels the rods are fitted not only with nuts, but with rubber shock absorbers.

The bogie of the locomotive follows closely the design of the full-sized G.W.R. bogie. This, with its bar frames and unique suspension, and special side control gear, is a mixture of British, French and American practice. It incorporates, in addition, special side bearings, that reduce rolling to a minimum and ensure a smooth passage over curved track.

(To be continued)

A Railway Track That Goes To Sea

S.R. Train Ferry Steamer "*Twickenham Ferry*"

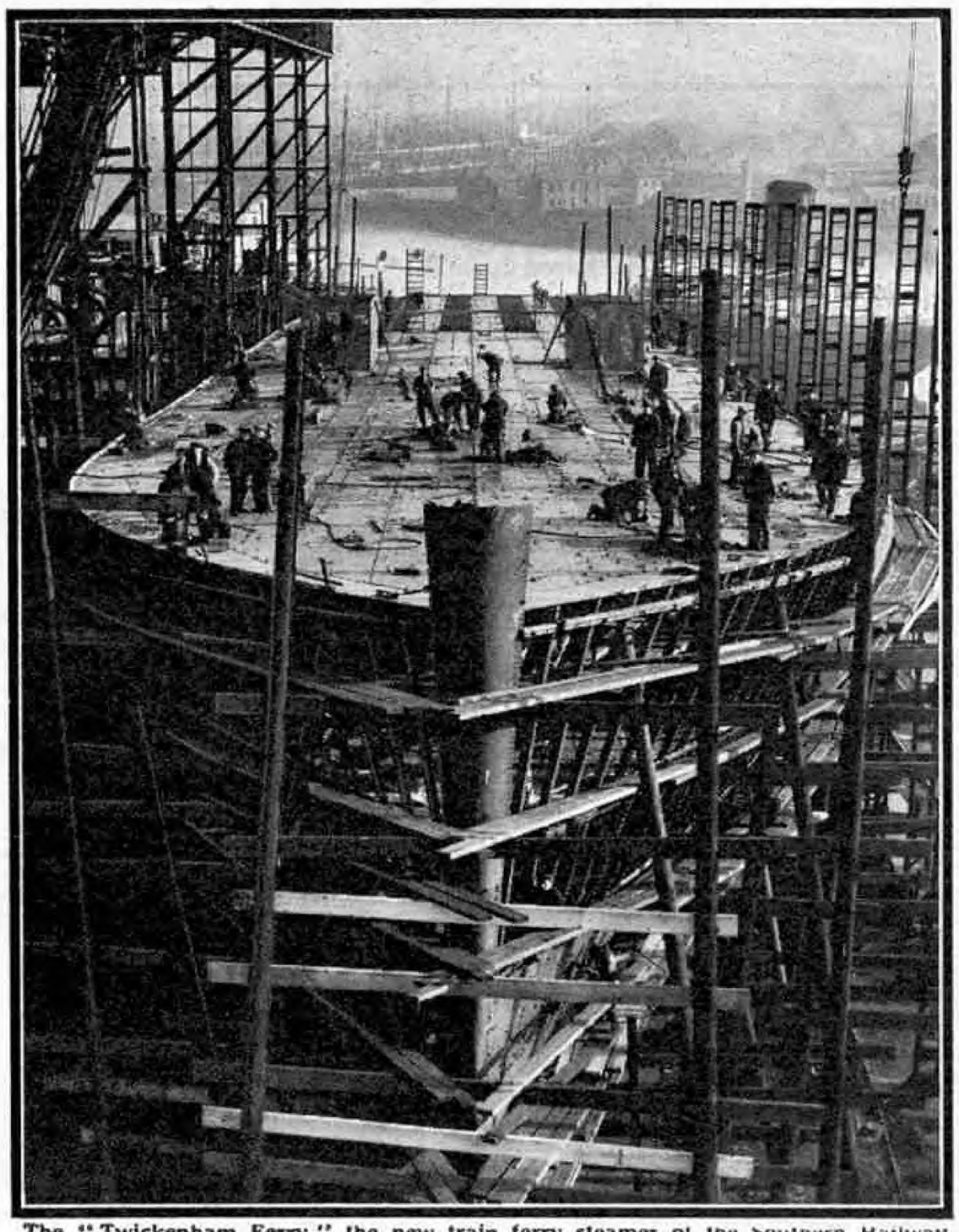
By "Observer"

TRAFFIC between Great Britain and the Continent of Europe is now of considerable magnitude, but a decided increase is confidently expected when the new Southern Railway train ferry service between Dover and Dunkirk is put into operation, probably in the summer of next year. It is believed that this new service across the English Channel will soon be one of the most popular with travellers on account of the facility and comfort with which the through journey will be effected.

Attractive prospects are conjured up by the plans that have been made and are now in course of being carried out. When the new services are instituted it may be possible for a passenger to get into a luxurious sleeping car at Victoria Station, London, at midnight, and to rest undisturbed until he arrives at Paris in time for breakfast next morning, because the train itself will be able to make the through journey. Travelling down to Dover by the usual route, the train will be transferred there to the train ferry steamer, to be carried across the Channel to Dunkirk, where it will be run off on to land again and will travel forward along the railway to the French capital or other destination as may be desired.

The new train ferry is not by any means the first of its kind, but every effort is being used to make it the best, and the experience that has been gained on other train ferries in many parts of the world has been carefully considered in designing this one. For 10 years past a regular train ferry has been operated by the L.N.E.R. between Harwich, on the coast of Essex, and the port of Zeebrugge, in Belgium, and by this route an increasing amount of merchandise has been carried in both directions between England and various Continental countries. It has been found to be a great saving of time, trouble and expense to be able to load wagons at any part of Great Britain, run them on to the deck of the train ferry at Harwich for conveyance to Zeebrugge, and thence work them through to their several Continental destinations. It has proved a particularly valuable gain to be able to pack delicate articles, such as fruit and fine hardware, and take them through without having to be disturbed or transferred.

In the formation of the Harwich-Zeebrugge train ferry extensive use was made of vessels, wagons and other material that had been used formerly in the train ferries between Richborough and Dunkirk, and Southampton and Havre, which were brought into being for the carriage of munitions during the Great War.



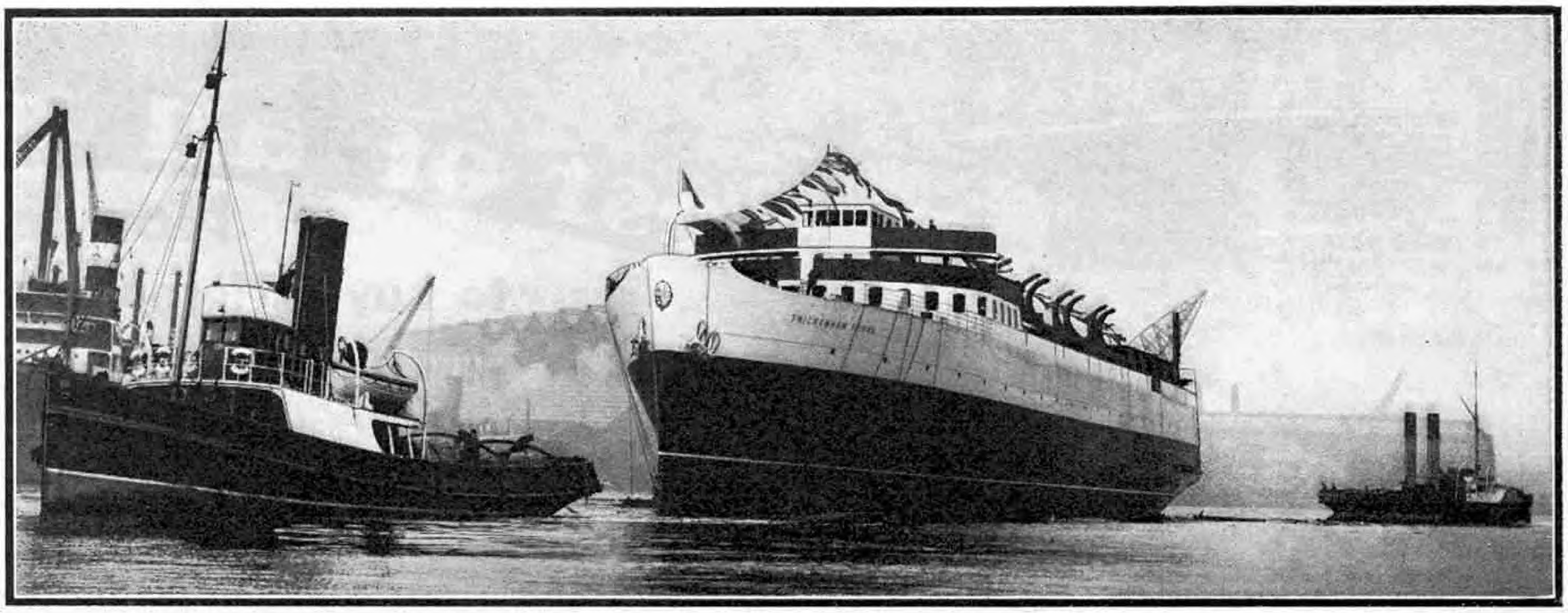
The "Twickenham Ferry," the new train ferry steamer of the Southern Railway, under construction. Four lines of rails will be laid on the deck.

Hitherto there has been no passenger train ferry service operating to and from Great Britain, although there are several services of this kind in America and in Northern Europe, in particular in Denmark, where there are nine in regular working. The new Channel train ferry is being designed to convey both passenger and freight vehicles, and so it registers a distinct advance.

At both Dover and Dunkirk extensive works are in hand for adapting these ports for the purposes of the train ferry. The most difficult problem is that of securing at all states of the tides a sufficiently level connection by means of which the trains can run from the land on to the ferry steamer and vice-versa.

The chief advantage of a ferry, as compared with a ship, lies in the ferry's ability to embark and disembark vehicles without using cranes. As the waters of France and England on each side of the Channel have a daily rise and fall of between 10 ft. and 20 ft., an inclined slip, such as is used for the reception of many road vehicle ferries, was out of the question in this case owing to the necessity of having a gradient suitable for railway operation. The alternative of providing locks that would enable the vessels to link up with the shores on level terms at any state of the tide was therefore adopted, and these locks are now being constructed.

Simultaneously with the work of preparation at the ports, three special steamers are being built for service on the ferry, and the first of them was launched on 15th March last at the Neptune shipyard of Swan, Hunter and Wigham Richardson Ltd., Walker-on-Tyne, where all three are building. Although sea-going vessels, they are primarily ferry boats, and are appropriately named after



The launch of the "Twickenham Ferry." This vessel will accommodate trains of 12 coaches or 40 wagons on the train deck, and on the upper deck a covered garage for 25 motor cars is provided, in addition to passenger accommodation.

three famous Thames ferries, "*Twickenham Ferry*," "*Hampton Ferry*" and "*Shepperton Ferry*."

The main service on which the ships will be engaged is to carry a train of 12 sleeping carriages, or alternatively 40 loaded goods wagons. For this purpose, therefore, four lines of rails are provided over the greater part of the train space on the lower deck. At the stern these converge into two tracks, by which the trains will pass on to the shore across a drawbridge at the end of the dock.

On the upper deck excellent passenger accommodation is provided, comprising dining saloons, lounge, smoke-room and private cabins, with ample space for promenading. A special garage, entirely isolated, also has been built on the after end of the upper deck to accommodate 25 motor cars, which can be driven on to the ship along an inclined ramp, the advantage being that the cars can be carried without any restrictions as to emptying petrol tanks, while motorists can use the passenger deck accommodation. If the traffic develops it will be possible to carry also heavy motor-driven vehicles on the after part of the train deck space, the surface between the rails being made level for this purpose.

Both the design and the building of the vessels have been carried out under the general direction of Sir Westcott Abell, K.B.E., acting for the Southern Railway. The geared turbines for propelling the ships are being supplied by C. A. Parsons and Co. Ltd., Wallsend-on-Tyne, and the water-tube boilers by Yarrow and Co. Ltd., Glasgow. After the fullest investigation it was decided to adopt coal as fuel, particularly as the coal can be run on board the ships direct in railway trucks and tipped into the ship's bunkers, without having been handled since leaving the collieries. The vessels are driven by twin screws and their speed on normal services will average 15 knots, but they should be capable of attaining a speed of over 16½ knots if required.

In designing the vessels some difficult problems had to be faced. To accommodate the trains the ship must have a width of rather more than 60 ft. The harbour conditions of the Channel ports restrict the extreme length to 360 ft., while certain considerations in regard to the possible use of the vessel limit its draught when ordinarily loaded to 12 ft. 6 in. The depth from keel to train deck is 20 ft. and the height of the train deck space 15 ft. 6 in. Thus one of the problems was to combine to the best advantage a bulky form above water with a fine form of hull below water; the fine form being necessary because the vessel's length is short for her speed and she is extremely broad in relation to her draught. An elaborate series of trials with models therefore was made at the National Physical Laboratory under the supervision of Mr. G. S. Baker, and these showed that it should be possible to obtain a speed of 16½ knots with about 5,000 h.p. delivered to the twin screws, 2,500 h.p. for each. Special experiments also were made with model propellers, and in connection with the steering gear and rudders that are provided at each end of the ships.

Principal Dimensions
of S.R. Train Ferry Steamship
"Twickenham Ferry":

Length overall	360 ft.
Breadth	60 ft. 6 in.
Depth	20 ft.
Engine Horse Power	5,000
Boiler Pressure	250 lb. per sq. in.

Safety considerations have received the closest attention from every point of view, and the watertight bulkheads have been so arranged that the vessels should remain afloat with any two adjacent compartments flooded. Each vessel is fully equipped with life-saving appliances sufficient for a total of 550 persons on board. She has four boats on each side, carried on gravity davits, making the boats instantly available for use in emergency.

Since the ship has been made extremely wide in order to carry the trains, it was found possible to provide additional wing bulkheads on each side extending nearly half the length of the ship. These wing spaces are nine ft. in width, and are divided into seven separate tank compartments on each side. In addition there are four water-tight compartments at the fore end and three at the after end.

Particular attention has been given to fire prevention. The motor car garage is entirely isolated and is constructed of steel throughout. The passenger accommodation on the upper deck is mainly of steel, so arranged that separate sections can be isolated; and an elaborate provision of fire-fighting appliances is made, especially on the train deck.

We are indebted to the Southern Railway for the information contained in this article and also for the accompanying illustrations.



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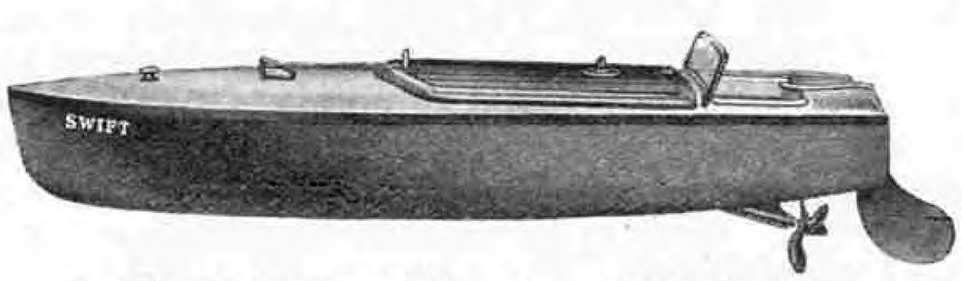
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HORNBY SPEED BOATS

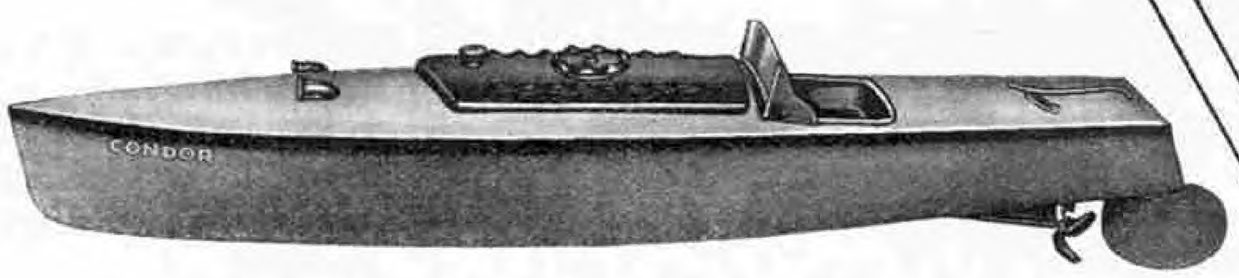
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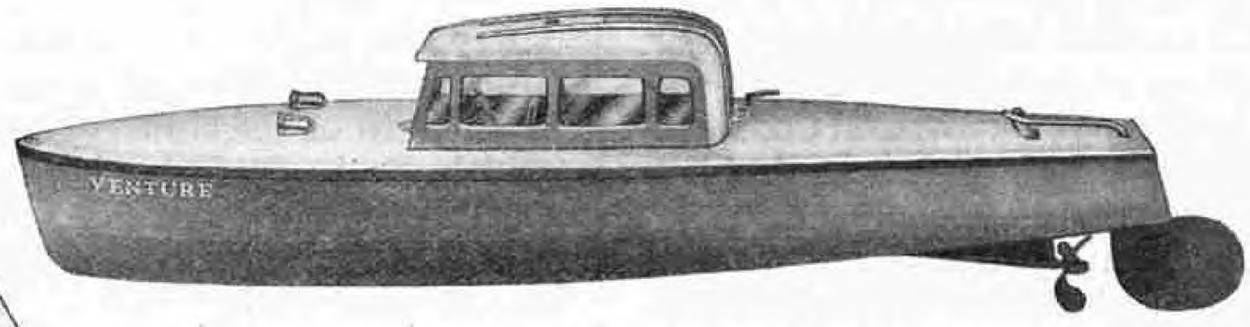
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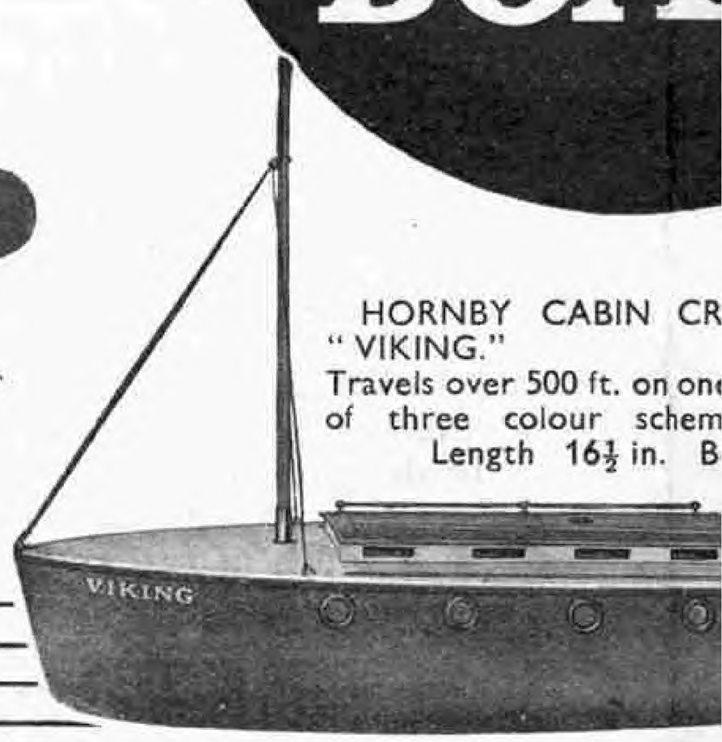
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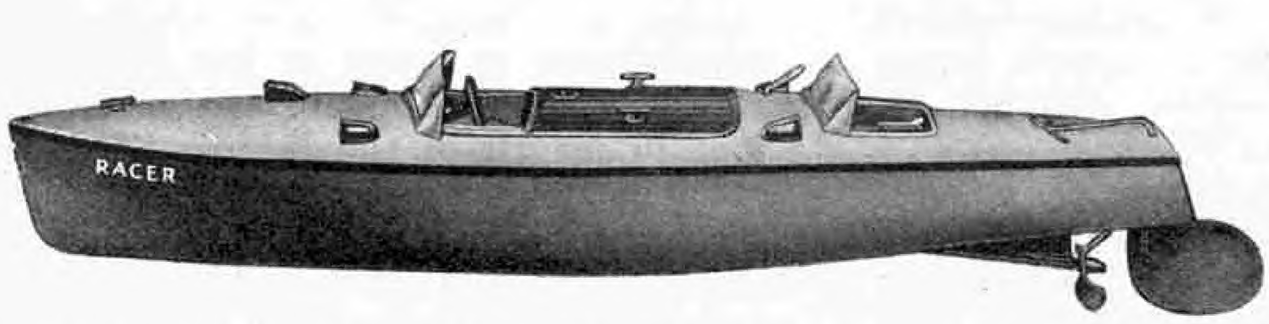


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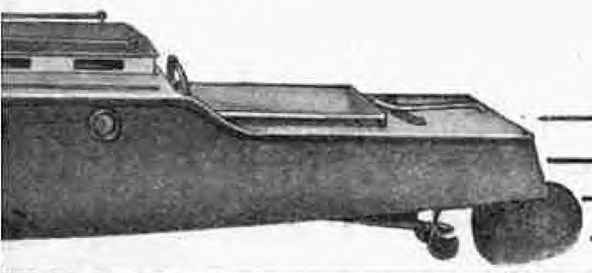




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An Historic American Bridge Site

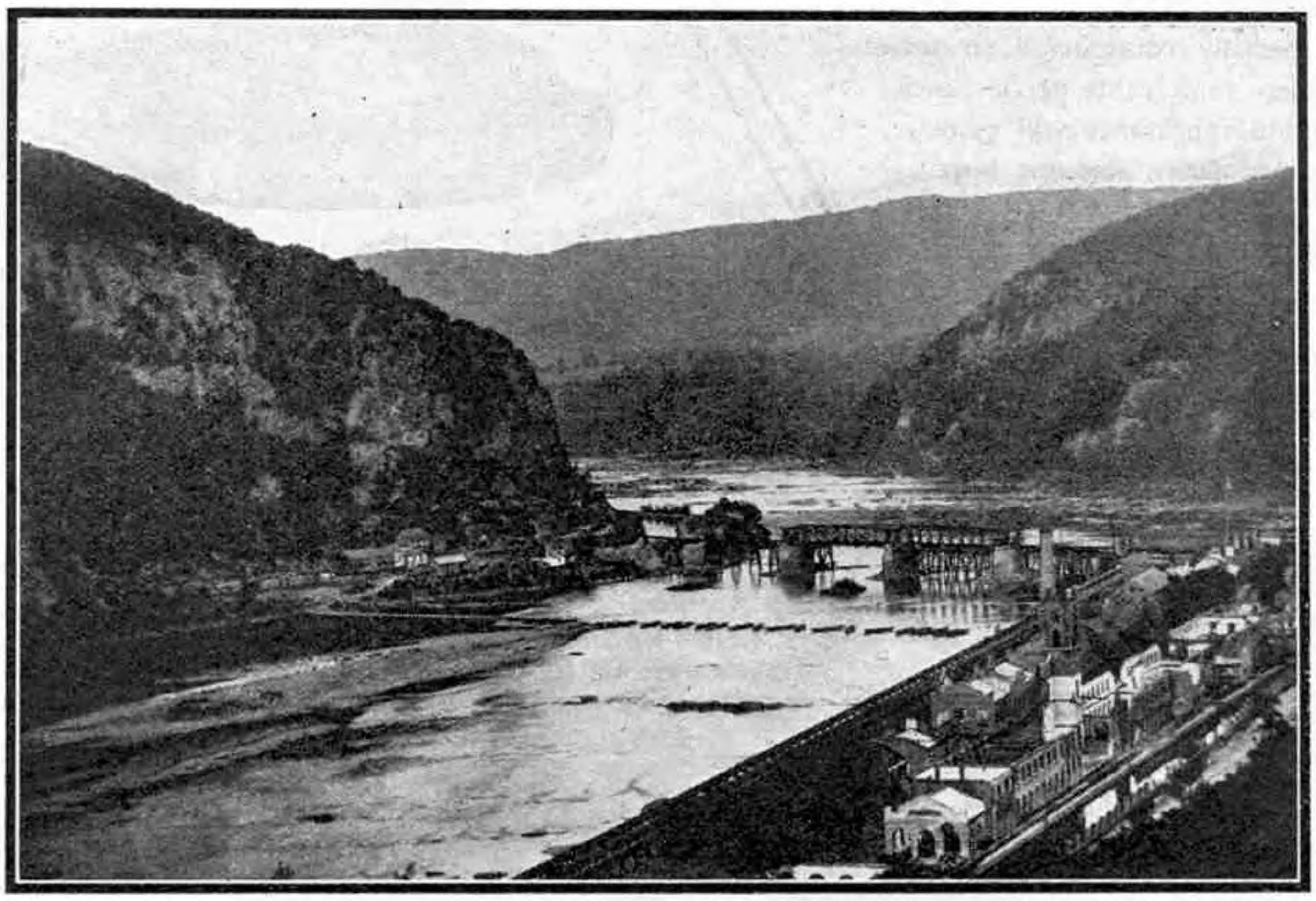
The Potomac River at Harpers Ferry

HARPERS Ferry, West Virginia, U.S.A., on the Potomac River at its union with the Shenandoah River, has a peculiar claim to historic distinction as the scene of important developments in the science of railway bridge design and construction. Each of the structures built by the Baltimore and Ohio Railroad Company to carry their tracks across the Potomac River at this point has reflected the practice current at the time of its construction; and it is a matter of singular interest that three of these bridges, built at widely different periods, still exist to illustrate the development of bridge building over a period of more than three-quarters of a century.

On 1st December, 1834, the tracks of the Baltimore and Ohio Railroad reached, in their westward progress from Baltimore, a point on the north shore of the Potomac River opposite Harpers Ferry. At this point further progress of the new line along the north shore of the river was barred by the precipitous ridge of Catoctin Mountain; and to the southward the Chesapeake and Ohio Canal and the Potomac River opposed a combination of obstacles for the surmounting of which the experience of that day afforded no guiding precedent. After a period of about two years spent in engineering investigation and construction the tracks of the railway passed across the river and into Harpers Ferry upon a bridge consisting of a series of wooden arches, designed by Lewis Wernwag.

This Harpers Ferry crossing consisted of wooden arches covered with timber sheathing in accordance with the practice of that day. By "arch" our ancestors meant any form of bridge superstructure other than a timber trestle; and it is probable that the Harpers Ferry Bridge actually consisted of wooden trusses. The first known structure of this character on the Baltimore and Ohio Railroad was that built to carry the line across the Patapsco River at Elysville (now Alberton), Maryland, in 1839; and this design, with various modifications, was used at numerous other places between that period and the introduction of the metallic bridge truss.

This wooden bridge continued to serve the needs of the railway from 1836 to 1851. The possibility of securing a structure better adapted to railway needs was early recognised, however, as is shown by the fact that within a few years the railway management gave serious consideration to reconstruction in different form. Between 1845 and 1850 the iron truss bridge had been introduced, and had won recognition as a type suited to the requirements of railways; and, during the autumn of 1851, the reconstruction of the Harpers Ferry Bridge in iron was commenced. For this purpose there was adopted the type of metallic truss developed by Mr. Wendel Bollman, for several years Master of Road of the Baltimore and Ohio, and afterwards a bridge builder of international reputation. During the succeeding year the reconstruction of the first span in this form, that at the western end of the structure, was completed. On 1st June, 1852, the action of the new iron truss span under three of the heaviest locomotives of that day was observed, with results that are summarised in the following quotation from a contemporary work:—



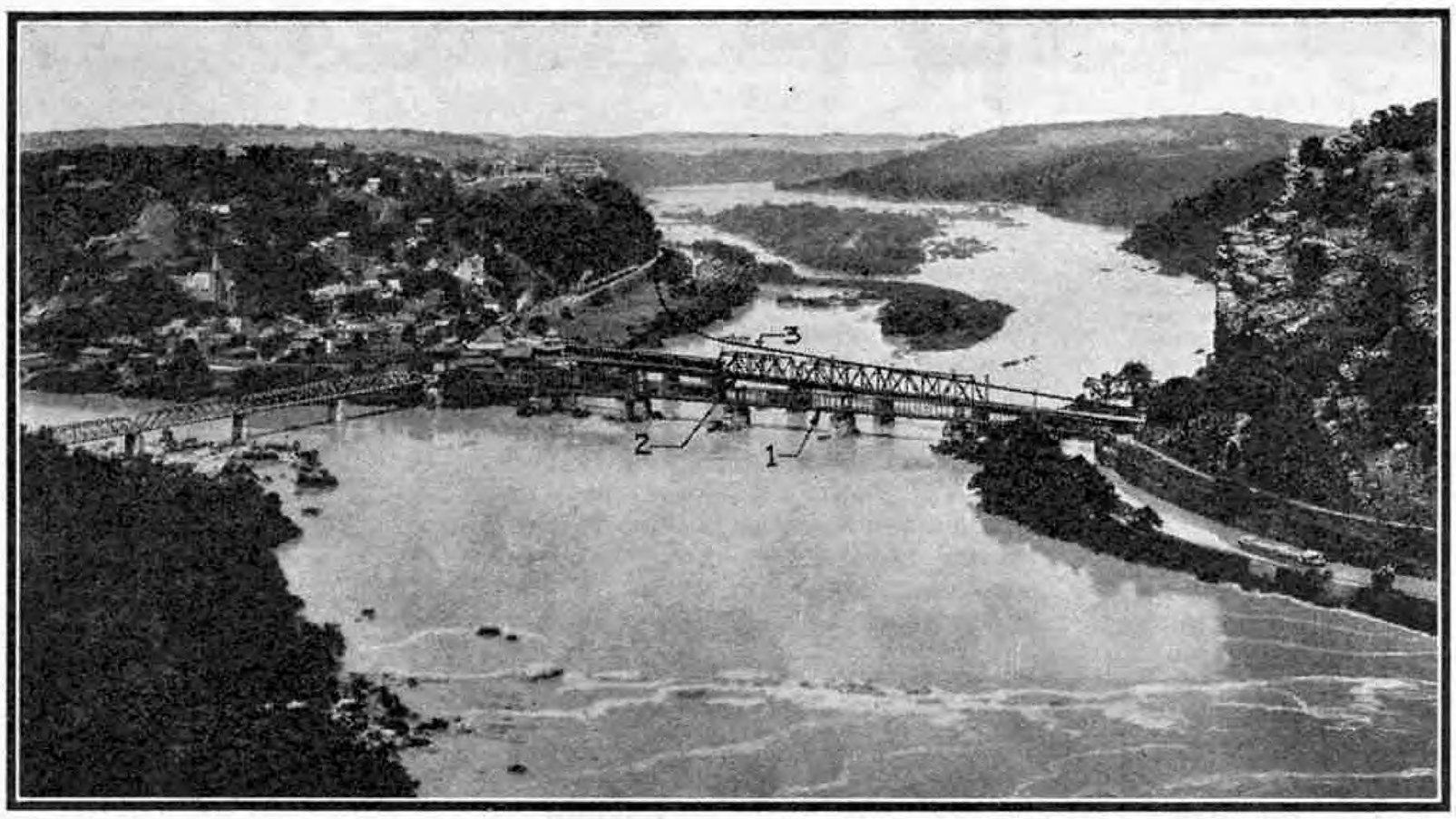
The bridge at Harpers Ferry, West Virginia, U.S.A., completed in 1894 by the Baltimore and Ohio Railroad, and used since that time by that company, to which we are indebted for our illustrations.

"Three first-class tonnage engines with three tenders were first carefully weighed and then run upon the bridge, at the same time, nearly covering its whole length, and weighing in the aggregate 273,550 lb. or 136.775 tons (of 2,000 lb.) net, being over a ton for each foot in length of the bridge. This burden was tried at about eight miles per hour, and the deflections, according to gauges properly set and reliable in their action, were at centre post $1\frac{3}{8}$ of an inch, and at the first post from abutment 9/10 of an inch."

A traveller who viewed this bridge in June 1857 describes it in the following words:—"The bridge is constructed somewhat in the shape of the letter 'Y,' dividing as we approach its western end, the left-hand branch connecting with the Winchester and Potomac Railroad, passing up the Shenandoah, and the right-hand carrying the main road, by a bold curve, up the Potomac. The bridge is about 900 ft. in length, and consists of six arches of 130 ft. and one arch of 75 ft. span over the

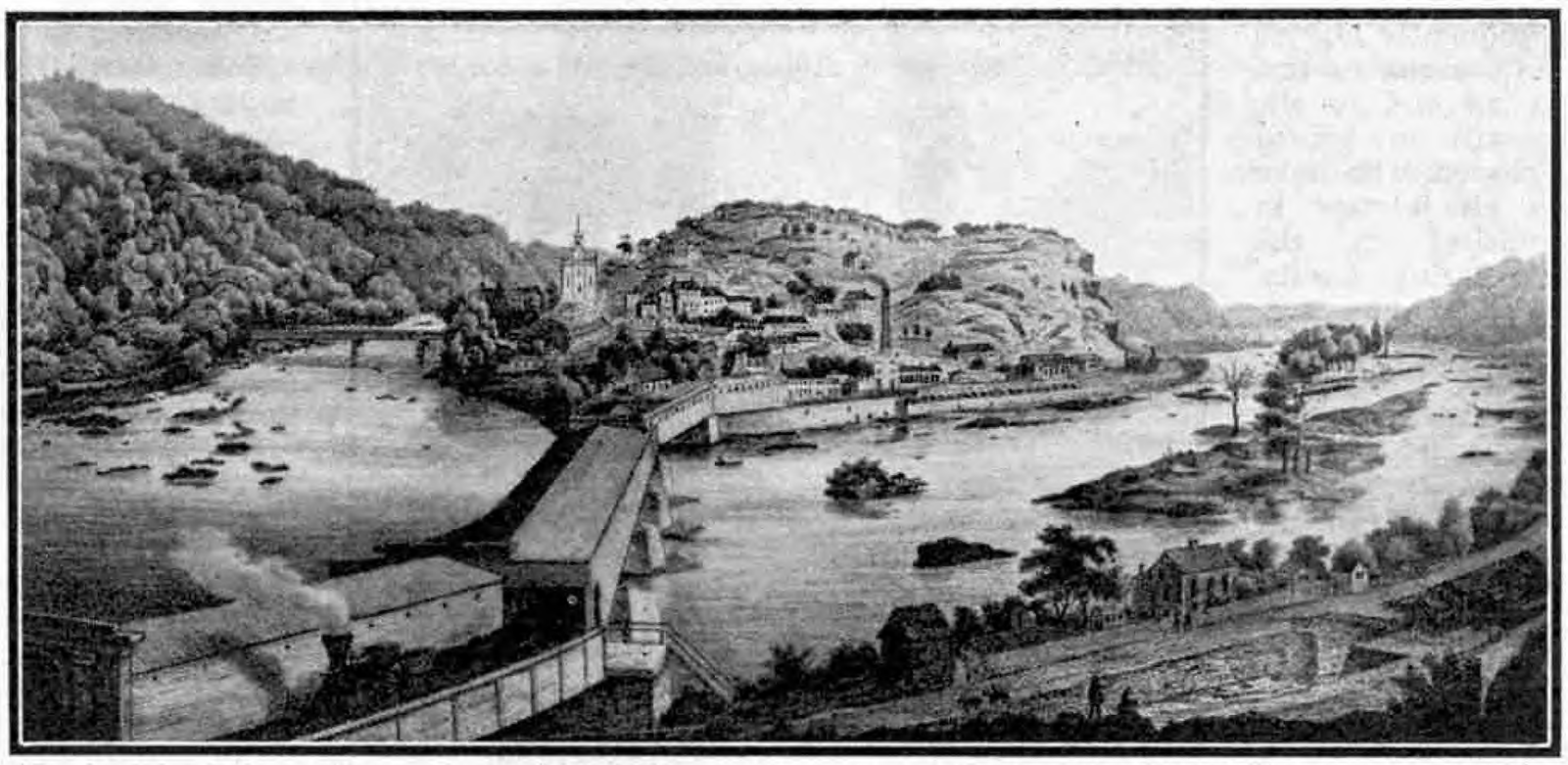
river and an arch of 100 ft. span over the canal. These arches are all of timber and iron, covered in, except the western arch connecting with the Winchester road, which is constructed entirely of iron, on Bollman's plan."

The situation of Harpers Ferry on the border between the groups of warring States naturally marked it as a spot in which the events characterising the approach nd progression of the Civil War had strong effects. On 14th June, 1861, seven wooden spans and the woodwork in the iron span of this bridge were burned by Confederate troops. Shortly afterwards Harpers Ferry was occupied by the Federals, and the construction of a trestle across the river was commenced by the railway company. The war impeded progress, however, and traffic was not restored over this structure until 18th March, 1862.



The line of the new Baltimore and Ohio Bridge under construction alongside the two existing bridges.

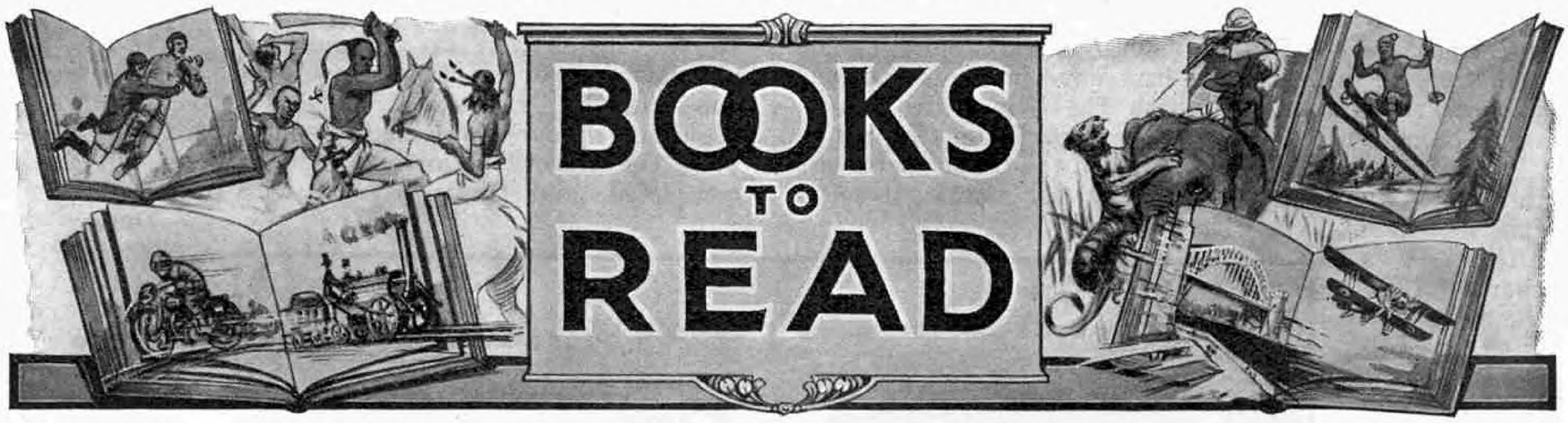
The strategic importance of this bridge, and the difficulty of maintaining trestles in the river caused favourable consideration to be given to the installation of four iron spans in the structure crossing the channel. This work was commenced during the summer of 1862, and in spite of the difficult natural conditions and troubles due to the war the four spans were completed on 13th April, 1863. They were demolished by the Federal cavalry, probably with the intention of impeding the Confederate retreat.


The old timber bridge at Harpers Ferry, with the first arch at the western end replaced by an iron Bollman truss. The bridge was used for railway purposes until 1894. It is now a road bridge.

By 1st August, 1863, Federal forces had regained complete control of the Baltimore and Ohio system, and a few days later through train service was restored. An improvised bridge was constructed at the Harpers Ferry crossing by means of trestlework, and the partial reconstruction of the iron spans, using for this purpose such portions of the metal as it was possible to salvage from the river. No further efforts were made towards the permanent replacement of the iron spans during the remainder of the war. In 1866, however, preparatory to the installation of a new metal superstructure, extensive improvements were made in the stone masonry sub-structure. Between 1868 and 1870 the work of rebuilding progressed steadily, and during the latter year the reconstruction of the bridge in iron was completed, and traffic over it was resumed.

During the succeeding 20 years the bridge continued to serve the needs of railway traffic, but the steady growth in weight and dimensions of locomotives and rolling stock, together with demands for increased speed and economy of operation, made inevitable the construction of a bridge better adapted to current requirements. The powerful explosives that had by this time become available rendered practicable the piercing of Catoctin Mountain with a tunnel, thus greatly reducing the curvature originally adopted on the north side of the river to circumvent this obstacle, and also improving considerably the reverse curvature that this arrangement had involved at the southern extremity of the bridge. In August, 1892, the construction of the tunnel and a new bridge was authorised and work was begun immediately; and on 12th April, 1894, the new line was opened. The old bridge is still in use as a toll bridge for the accommodation of highway traffic. Subsequent to 1894 railway requirements became still more exacting, and finally a definite project was adopted that provided for the construction of a new bridge crossing the river on a tangent of the line through the tunnel.

In the upper photograph on this page there is seen the Bollman truss bridge (1) completed in 1870, used for railway purposes until 1894 and since used for road traffic. Next comes the railway bridge (2) completed in 1894 and since used by the Baltimore and Ohio Railroad. Finally there is indicated (3) the line of the new bridge on the tunnel tangent.



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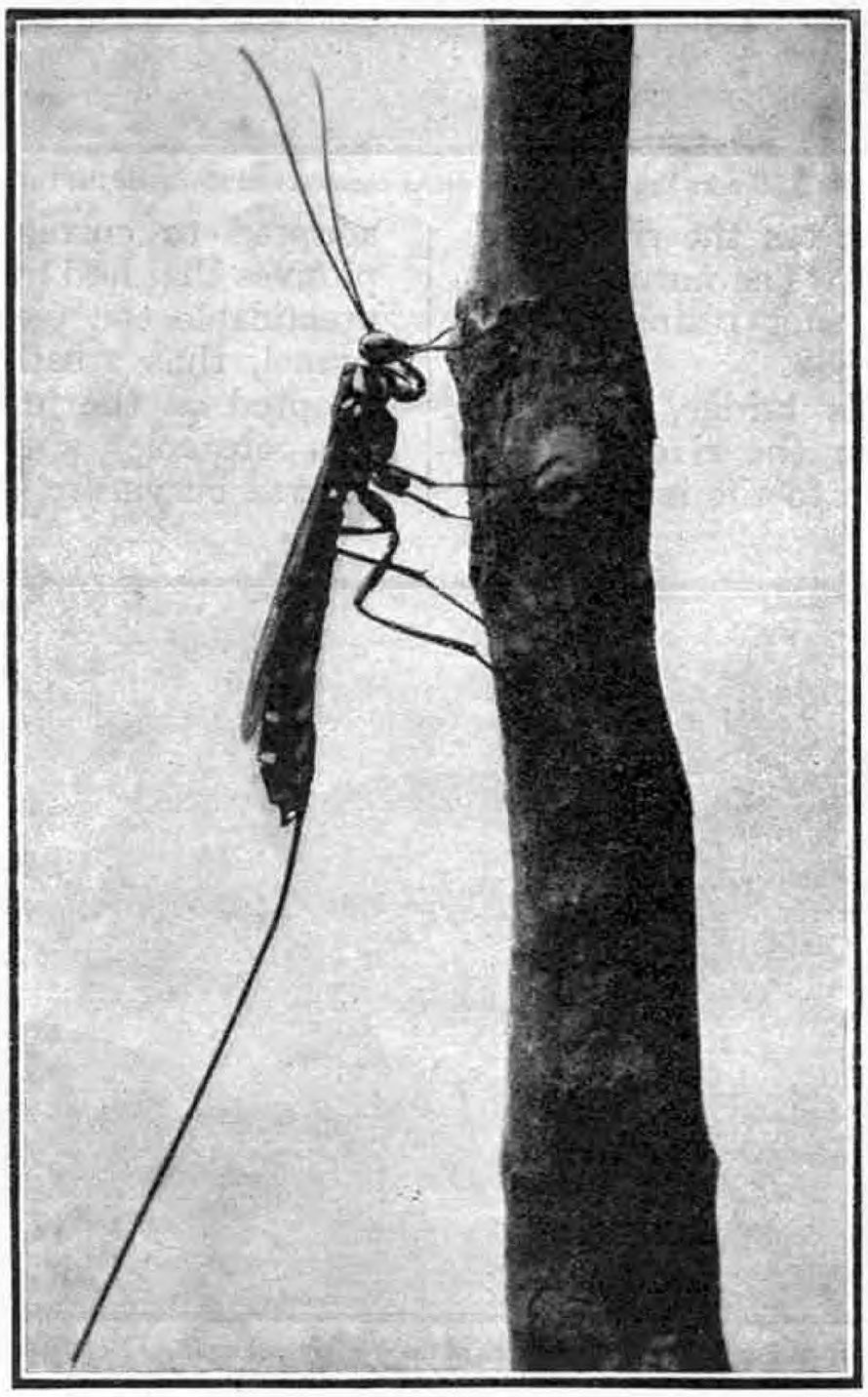
By Edward Step, F.L.S.
(Frederick Warne & Co. Ltd. 10/6 net)

It is not very long since bees, wasps and ants were thought to be of little importance, and certainly not worth the attention of serious scientists. This belief was shown to be wrong by Lord Avebury, who surprised the world by his revelations of the wonderful life stories of these insects; but even yet these creatures have not received the attention they deserve. As the author of the present volume says, "the average man considers that he can distinguish a bee from a wasp and either from a fly, but some of his wasps also are flies and others are bees." One reason for this is the great variety of both bees and wasps; another is that many flies and some bees wear imitations of the wasp's livery for the purpose of deceiving birds, lizards and other insect eaters, and in doing so they frequently impose on man himself. The present volume will do much to put an end to the uncertainty that prevails in regard to these insects, and readers who have not previously taken an interest in them will be astonished by the revelations of their amazing habits.

The story begins with the humble-bees. These have not acquired the fame of the honey-bees, which are not native British insects, but have long been regarded as models of industry and forethought because of their habit of storing up a surplus of honey. They are as important as their more famous relatives, however, for upon their search for nectar we depend for our flowers and fruit crops. If they and other less-known bees were exterminated the world would quickly change its aspect, and nuts and cereals would be the only fruits on which we could depend for food.

This leads on to the interesting story of the cuckoo-bees, which enjoy life like other bees, visiting flowers and sipping nectar, but shirk home duties. They force their way into the nests of humble-bees and, after killing the mother bee, compel the workers to take charge of their own offspring. Occasionally, however, when the cuckoo-bees invade a well-established nest with a large population of workers, they meet with fierce resistance and a desperate fight takes place. Such a combat usually results in the destruction of the invaders, but only after a grim struggle in which many of the workers also are killed.

The humble-bees and honey-bees form well-organised communities in which each member carries out its appointed task with admirable efficiency. There are other bees that work singly, however, and these are known as the solitary bees. We are as greatly indebted to them for fertilising flowers as we are to the better known humble-bee, and the success of the plum and pear crops in particular depends on the activities in Spring of the earliest of these interesting bees. Some of them are miners and burrow in the earth, or in the dead stems of plants, in order to find safe places for their cells. Others are carpenters, working in wood rather than in soil, either tunnelling through the softening remains of dead trees and posts or taking possession of burrows excavated by more powerful insects or of nail holes or other cavities. The activities o. some of these carpenter bees are responsible for the disappearance of circular sections of the leaves of many garden plants, for they cement the pieces together to form thimble-shaped cells. Finally, to the story of the social and solitary bees is added that of the homeless bees, wandering creatures of unsettled habits that only possess homes in the early stages of their existence, when they develop in the burrows of more settled species into which they have been introduced cuckoo-fashion.



Ichneumon fly searching for burrows of wood-boring wasps in which to lay its eggs. (From "Bees, Wasps, Ants and Allied Insects," reviewed on this page.)

The activities of the many British wasps are next dealt with. These are not all the irritable, bad-tempered creatures they are generally supposed to be. Actually they are disposed to ignore human beings, and it is possible to sit quietly at the doorways of their nests for hours without being disturbed. It is interesting to read that the wasp is the inventor of the wood pulp paper on which our newspapers are printed. Unlike the bee, she has to find material for the construction of her home, and she has learned to chew shreds of wood into a pulp that can be moulded to suit her requirements. She is also an efficient municipal engineer, for her home is so constructed that it can readily be made larger in order to meet the demands of a growing population.

Some wasps construct their nests in underground caves. Others suspend them from the branches of trees or seek such strange places as the soft mortar of walls, and there are lazy cuckoo wasps that invade the nests of the more industrious species. As in the case of the bees, there are social wasps and solitary wasps, and the mining and carpenter bees also have their counterparts among the wasps.

When we turn to the ants the interest deepens, for the ant community is one of the greatest marvels of natural history. A single nest may contain one or more queens, stay-at-home creatures that, after ridding themselves of their lumbering wings, devote their lives to laying eggs in the countless cavities of their nests. Some of the ants are peaceful and industrious; others are war-like; and some of the latter seem to have lost all domestic virtues, and to depend on captive ants of other species for carrying on the work of their nests. Their raids lead to fierce struggles, but when the stress of battle has subsided captors and captives appear to form a satisfactory partnership, for the smaller workers are valued and protected by their owners.

Finally we come to the many species of flies that are native to this country. These include the sawflies, the females of which are provided with minute saws that are used for cutting out the pockets in twigs, stalks, or leaves in which they lay their eggs; the gall-flies, which are

responsible for the hard lumps formed on trees and plants, of which the best known example is the oak apple; and a host of other tiny creatures, many of which live during the pupa stage at the expense of larger flies, and are themselves the hosts of still smaller parasites.

The fascinating life histories of all the creatures dealt with in the book provide absorbingly interesting examples of the ingenious devices nature adopts to preserve life and to fit living things into her plans. The author covers the ground fully, and in great detail, but without any unnecessary technicalities, and thus has produced a book that will be a source of pleasure to general readers as well as to those who are particularly interested in nature study. The many excellent illustrations contribute largely to its value. There are more than 100 plates, showing 470 insect figures in colour, and 170 splendid photographs of insects in their homes at various stages of their existence, at work in the fields, or in their nests when fully grown. In addition there are many useful diagrams of insect forms, and 64 wing maps that can be used to identify the creatures described.

Jewels of Romance and Renown

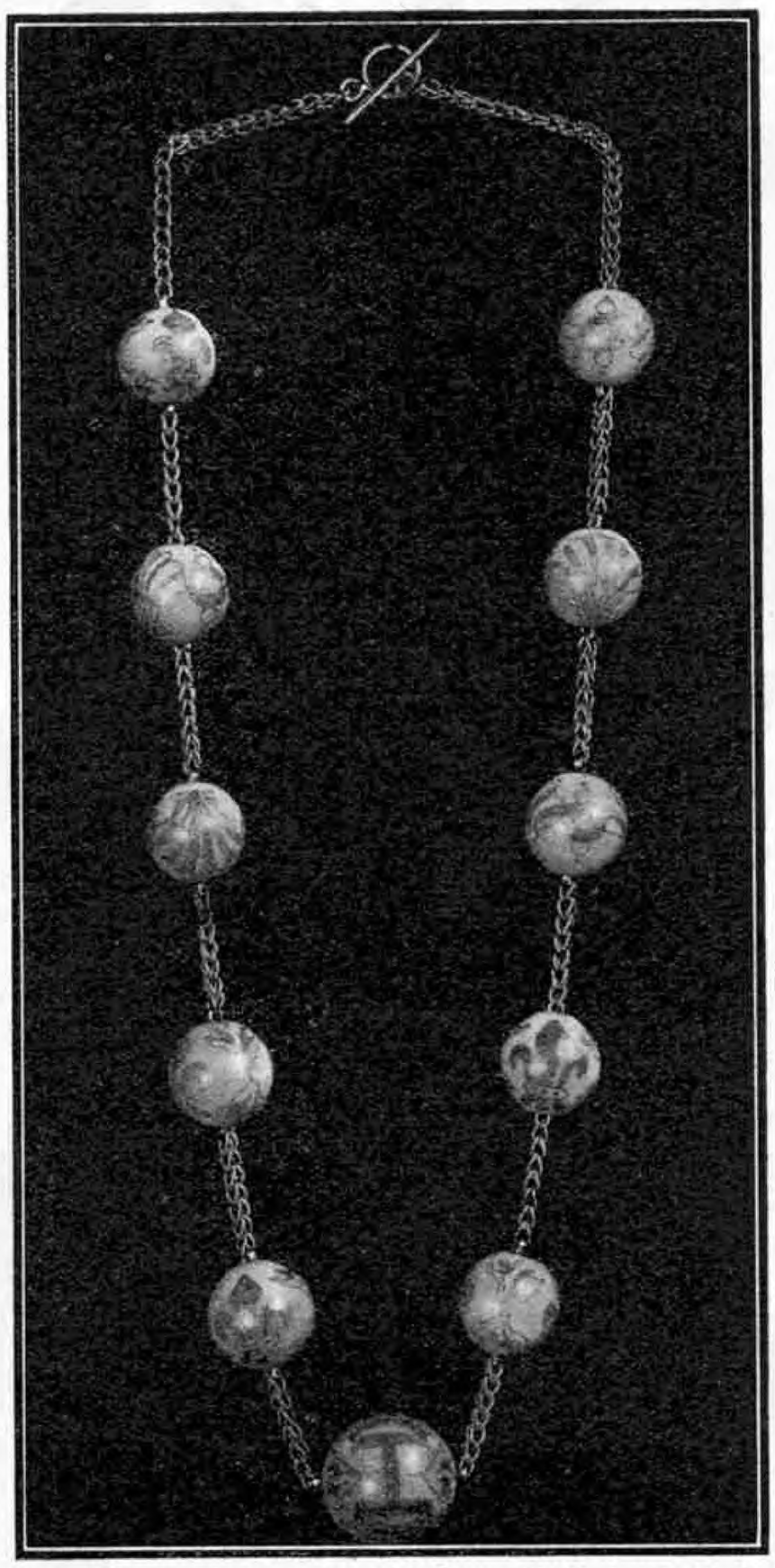
By MARY ABBOT. (Wernie Laurie. 8/6)

Nothing stirs the imagination more than the stories and legends that surround all famous jewels, and Miss Abbot has done her work well in recounting much of interest in connection with the fascinating subject. A glance through the contents list shows chapters on Diamonds of Destiny, Rubies of Royal Heritage, Pearls of Great Price, Sapphires that made History, Mystical Opals, the Rings of Kings and Queens, Fantastic Jewels, Treasures of Jade, Crowns of History and Mystery, and so on.

The recent discovery of two large diamonds in South Africa lends particular interest to the author's remarks about the Cullinan diamond, because it has been suggested they form the other half of this famous stone. Uncut, the Cullinan diamond weighed 3,025 carats and measured 4½ in. across. It was mined in Pretoria in 1905 and was presented to King Edward in commemoration of the granting of self government in the Transvaal. The diamond "travelled from South Africa to England in an ordinary wooden box, and consigned through the post without any special declaration, but that was done to bluff some expert thieves who were known to be on the look out for it, an episode which rather heightens than lessens the glamour of the jewel. Especially as the watching thieves actually did confiscate another box ostentatiously registered and insured." The King ordered that the diamond be cut into two pieces, and these now adorn the Imperial crown and the royal sceptre.

The largest opal ever mined is 4 in. in length and 2½ in. in thickness and at present is in the Museum at Vienna. An offer of £25,000 for it was refused. At one time Hungary alone supplied the world's opals, but these now come from Australia and Mexico.

Of the stories of fabulous riches, that of the Persian Crown Jewels is perhaps the best known. Thrilling tales have been told of the famous jewels of Persia, "of sacks full of sapphires, tubs full of rubies, tanks crammed with turquoises, to say nothing of cupboards choked with belts and gauntlets massed with pearls and swords scabbarded with diamonds and goblets rimmed with emeralds!" Even though this legendary impression of enormous riches has been denied recently by the Shah, the strong room at the Palace of Teheran must still be much of an Aladdin's Cave. In a valuation made recently by European experts it was estimated that there were at least 13 lb.



Ivory pique necklace presented by Queen Marie Antoinette to the Princess De Lamballe, one of the victims of the French Revolution. It is now in the Wallace Collection. (From "Jewels of Romance and Renown," reviewed on this page.)

weight of emeralds alone, the largest of which was valued at £15,600. In England the emerald fell from favour during the 19th century, partly due to Queen Victoria's love for diamonds, but is now again becoming popular.

H.R.H.—A Pictorial Biography

Edited by EDGAR MIDDLETON
(John Lane, The Bodley Head Ltd. 5/- net)

Perhaps the greatest tribute that could be paid to the personality of the Prince of Wales is the eager interest in his activities that is displayed in every country he has visited, for he is as popular in the United States, the Argentine, Chile and elsewhere as he is in the British Isles and in every part of our great Empire. This pictorial record of his career therefore will be greatly enjoyed by its readers; and it also will help to explain the immense popularity of the Prince and the respect in which he is held in all quarters and by all classes of the community.

The book contains a brief account of the principal events of his career, but its chief interest lies in the wonderful series of photographs that follow. These start with the Prince as a baby in 1894 and enable us to follow his career step by step. The years of childhood are succeeded by his entry into the Royal Navy College at Dartmouth, and then comes a splendid pictorial record of his investiture as Prince of Wales at Caernarvon in 1911, an event that may be said to have marked his entry into public life.

Next we see the Prince at Oxford, where he was treated in the same way as any other undergraduate, being allowed no privileges. The orderly development of his career was then suddenly interrupted, as was that of millions of other young men in the country, by the outbreak of the Great War. He was not allowed to go to France immediately, as he wished, for fear of capture by the enemy. Eventually he had his own way, however, and in a splendid series of photographs we see him with the troops at the front and even in the trenches, to which he penetrated whenever he could find a reasonable excuse, often to the dismay of those responsible for his safety.

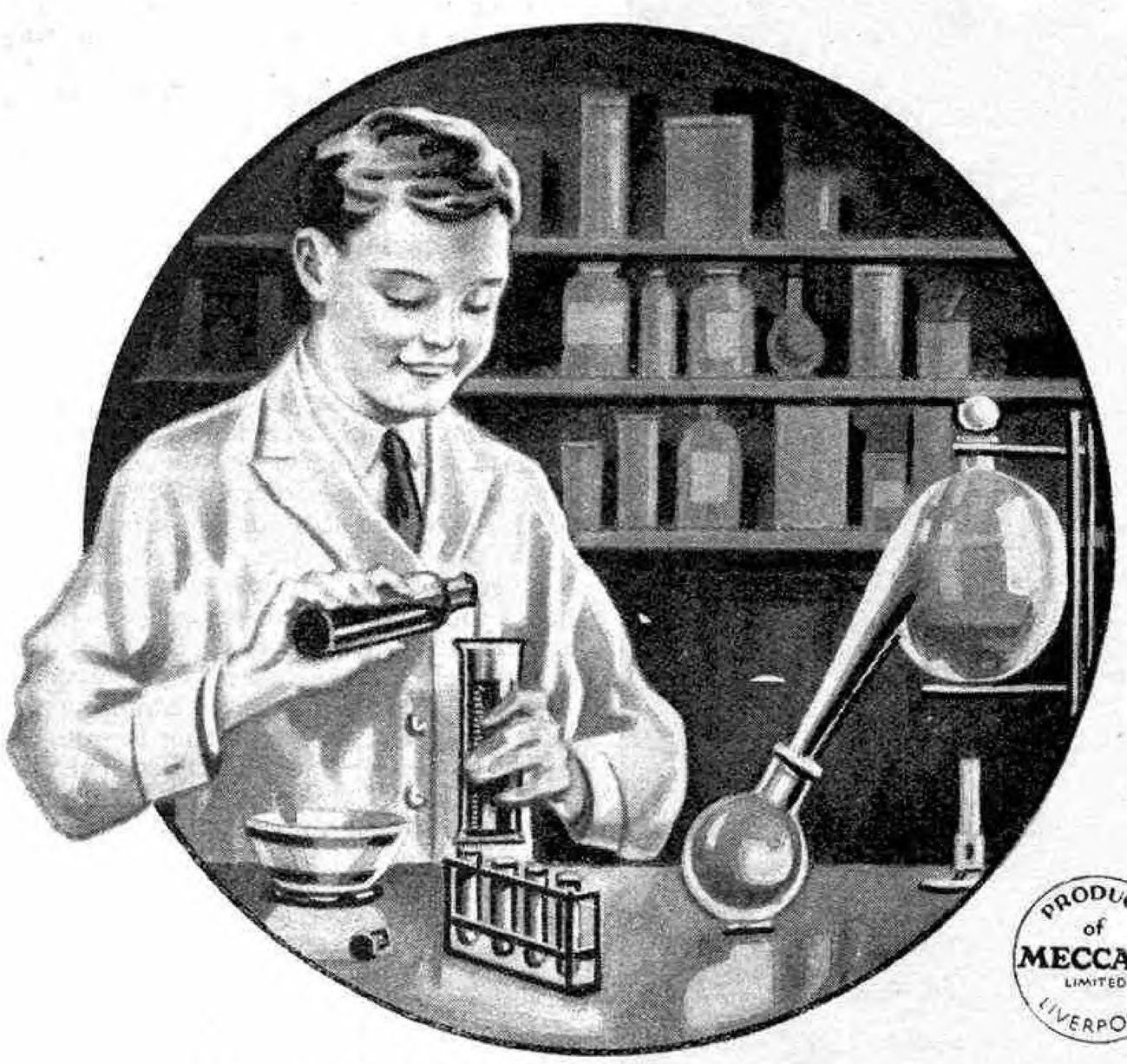
At the end of the War the Prince had grown up. In his own words, he had found his manhood, and he began a career of travel that is absolutely unparalleled in the story of anyone so highly placed. He visited almost every part of the Empire, exploring thoroughly every corner of South Africa, Australia, New Zealand, Canada and other countries included in his extensive world tours. The wonderful photographs included in the book show that he was at home everywhere and the delightful lack of convention they reveal justify the enthusiasm that he invariably aroused.

The Prince's travels have not been confined to the Empire, and he has achieved equal success in countries so widely different as the United States, Japan and the Latin republic of South America. Twice he has been welcomed in the Argentine, and his visits to this and other countries have helped to promote international understanding and have earned him the title of "Ambassador of Empire."

In between these visits he has hunted big game in East and South Africa and has enjoyed holidays on his Canadian ranch. At home he has revealed the greatest interest in every phase of our national life, showing himself a sportsman in the hunting field and on the golf course, encouraging useful movements and activities of all kinds and making friends with the humblest of people in their own homes. We follow him in all these activities, appreciating the qualities that have made him so popular, and our last glimpse of him shows him leaving Buckingham Palace as his father's deputy on a great ceremonial occasion in London only last year.

The book is claimed to be the first pictorial biography ever published, and the hundreds of photographs that make up its fascinating record fully justify the statement, with which the brief biographical section ends, that "No Heir to the Throne in this or any other country ever achieved a wider knowledge of the life, or a closer acquaintanceship with the problems of the man in the street than has Edward, Prince of Wales."

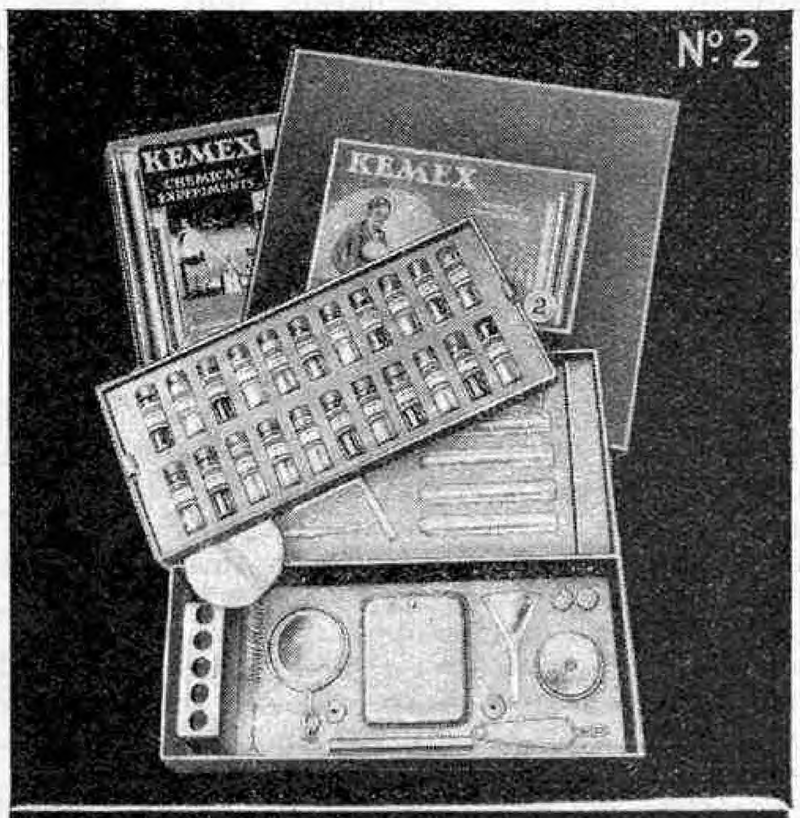
MECCANO KEMEX CHEMICAL OUTFITS



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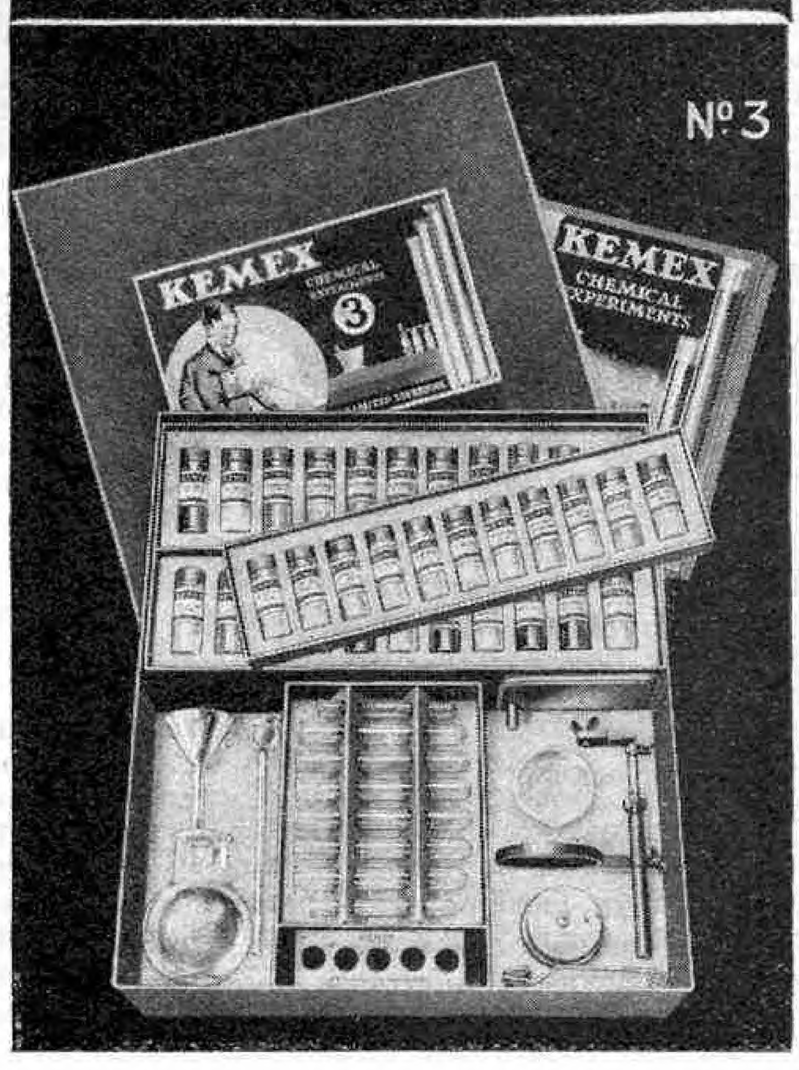
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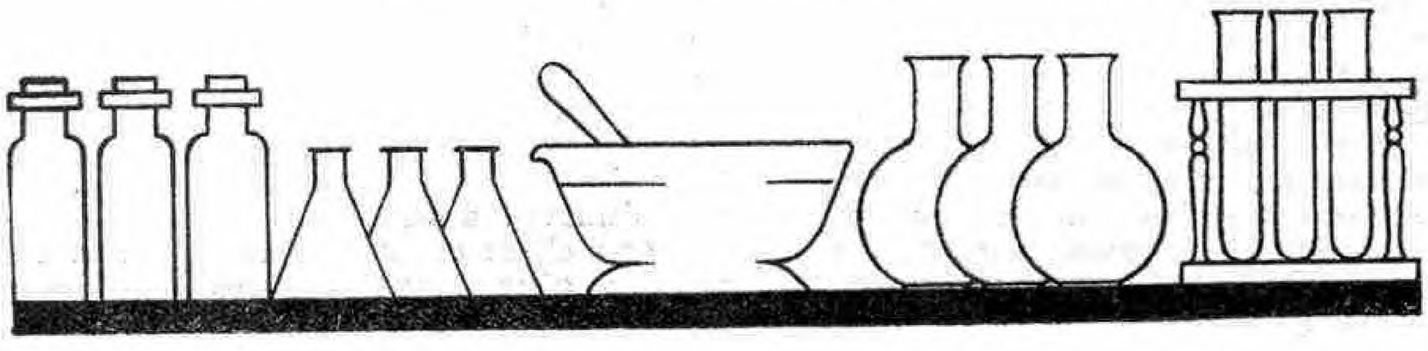
This is a splendid complete Outfit that provides a boy with all he requires to carry out between 350 and 400 experiments, and thus enables him to acquire a sound knowledge of the fascinating principles of chemistry. The Outfit includes the contents of the No. 2 Outfit, with additional chemicals and apparatus, that open up a series of experiments of outstanding interest on similar lines to those performed by actual chemists. Price **25/-**



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SEPARATING METALS FROM THEIR COMPOUNDS

SIMPLE experiments in which metals are obtained from their compounds are very attractive to experimenters, and interesting examples of chemical changes of this kind can be carried out with Kemex Outfits. For instance, those who possess a No. 3 Outfit, or have added a blowpipe and a charcoal block to the contents of a smaller Outfit, can extract copper, iron, nickel, cobalt and other metals from their compounds by mixing these with washing soda and heating the mixture in the blowpipe flame.

Simpler experiments of this type can be performed by owners of all Kemex Outfits, for there are interesting chemical reactions that yield similar results without the aid of high temperatures. For instance, copper can be obtained from Copper Sulphate by the action of other metals. Iron is one of the metals that will displace copper in this manner, as all those know who have dipped the blade of a penknife into a solution of copper sulphate, for the bright steel then becomes covered with a brown coating.

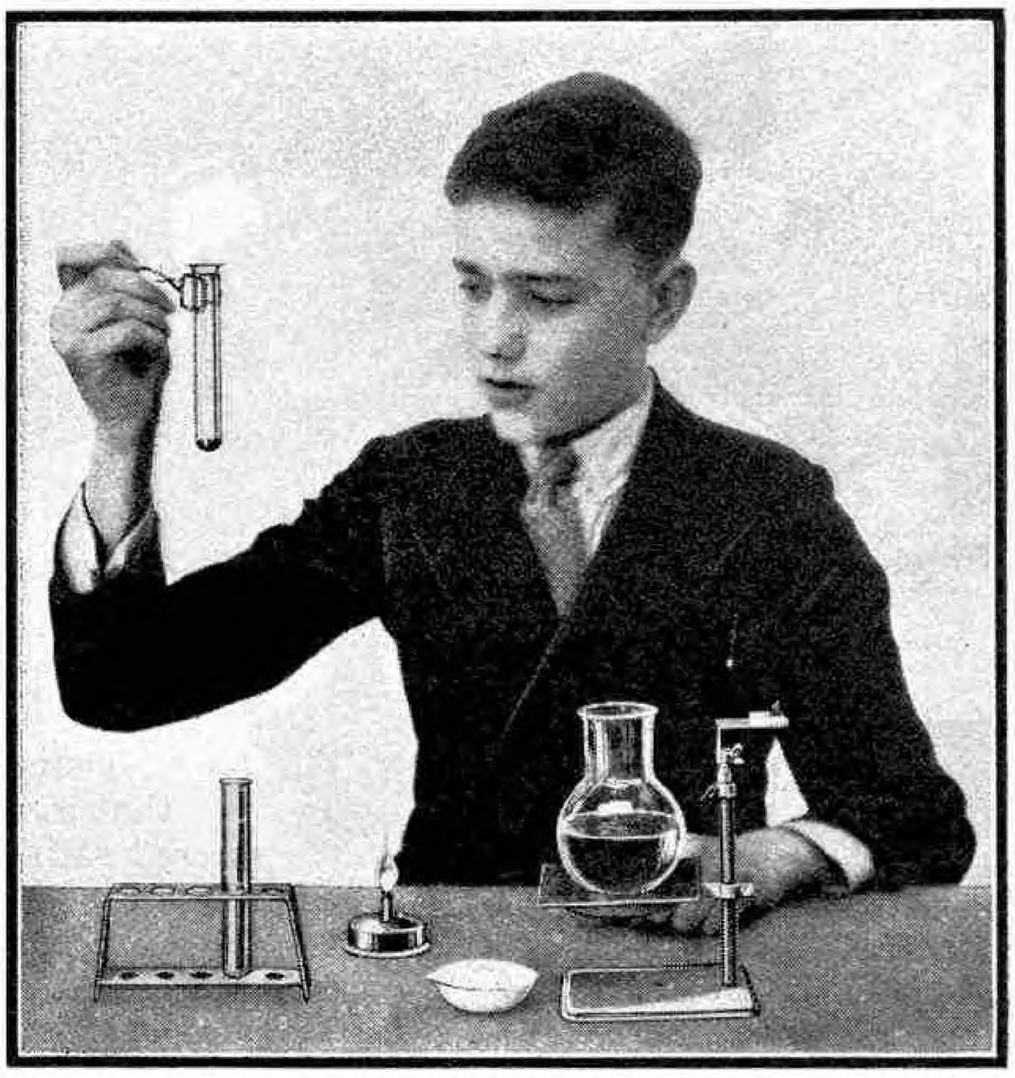
Turning Copper out of Copper Sulphate

A more suitable metal for effecting this interesting chemical change is zinc. In order to show how the action proceeds in this case, a solution of Copper Sulphate is made by shaking six measures of this chemical with one-third of a test tube full of water. Two or three small pieces of Granulated Zinc are dropped into the liquid, which is heated to boiling point. The Zinc then dissolves and a dark brown powder appears in the test tube. This powder is copper, zinc having taken its place with the formation of zinc sulphate.

If the solution remains blue in colour after all the zinc has disappeared from sight, more zinc is added, and the solution is again boiled. This is continued until a colourless solution is obtained, showing that the whole of the copper present has been displaced from the solution.

The experiment can be carried out on a larger scale in the evaporating dish or the wide-necked flask, the vessel in each case being supported on the evaporating stand. The copper formed is readily separated from the liquid by filtering, but if it is required in the pure state any pieces of Granulated Zinc that remain undissolved must be removed. As much liquid as possible is poured through a funnel, fitted with a filter paper, without disturbing the solid at the bottom of the vessel. Large pieces of Zinc can be lifted out with the aid of a glass rod, and dilute hydrochloric acid or dilute sulphuric acid is added to dissolve smaller fragments, for these liquids have no action upon copper. When the effervescence caused by the production of hydrogen ceases, the whole of the contents of the vessel are shaken into the filter paper. The copper remains in the paper, and is washed free from zinc sulphate by pouring successive small quantities of hot water through it. Finally the filter paper is left in a warm place in order to dry the metal. This is left in the form of a brown powder that can be scraped off the paper and placed in a container in readiness for use in further experiments.

The product of this chemical action does not look like a metal. It can easily be shown to be copper by dissolving it in nitric acid, however, for then it forms a blue or green solution of copper nitrate. Heating a portion of the brown powder in a dry tube supplies a further proof, for it turns black because of the formation of copper oxide.



Separating copper from one of its compounds. Examining the result of boiling Copper Sulphate Solution with Granulated Zinc.

Another metal that readily displaces copper from Copper Sulphate is Magnesium, and a small strip of this boiled or warmed with Copper Sulphate solution, prepared as already explained, gives the metal in the same form as that in which it is displaced by zinc. Iron also displaces copper from Copper Sulphate, and the experiment is carried out in exactly the same manner as those already described.

It is interesting to try other experiments of this kind in order to find which metals can be most readily displaced. Since zinc, iron and magnesium displace copper from Copper Sulphate, it would be useless to employ copper to displace any of these metals, but the effect of boiling Granulated Zinc in solutions of Ferrous Ammonium Sulphate, Cobalt Chloride and Nickel Ammonium Sulphate can be tried.

Extracting Magnetic Metals

A solution of Ferrous Ammonium Sulphate is made by shaking six measures of the chemical in a third of a test tube full of water. Several pieces of Granulated Zinc are added, and the mixture is gently boiled for a few minutes. The contents of the tube are then filtered, and it will be noticed that the pieces of Granulated Zinc remaining in the funnel are covered with a deposit that is rusted in appearance. The residue in the filter paper is dried, and a magnet brought near it then attracts it strongly, showing that the deposit contains metallic iron. The rusted appearance is due to the formation of a coating of iron oxide on the metal itself.

Boiling solutions of Cobalt Chloride and Nickel Ammonium Sulphate with Granulated Zinc in the same manner yields cobalt and nickel respectively. As in the case of iron, these metals are deposited on the zinc, and their presence can be detected by the action of a magnet, for like iron they are strongly attracted.

These experiments show that copper can be turned out of its compounds fairly easily. Iron, cobalt and nickel are more difficult to displace, and it is practically impossible to set zinc and magnesium free from solutions of their compounds. These results have led chemists to form what may be described as a displacement series. In this the metals are arranged in such an order that each displaces the metals coming after it, and in turn is displaced by the metals preceding it. A simple series of this kind is magnesium, zinc, iron, cobalt, nickel, lead and copper. Gold would come at the end of such a series and in the gold mining industry zinc actually is used to precipitate this metal.

British Marine Engine History in Meccano

III.—Screw *versus* Paddle Wheel

THE disadvantages of paddle wheels were realised from their earliest application to ships, their main drawbacks being their great weight and unwieldiness, the undesirable greater beam that they added to vessels, and their varying efficiency owing to the difference in the draft of a vessel when loaded with different cargoes. As regards warships, the drawbacks were even more serious. The wheels were exposed to gun-fire, and some of the propelling machinery had to be placed above the waterline. In addition, the position and size of the side wheels limited the number of guns that could be used for broadside firing. It is not surprising, therefore, that marine engineers and others interested in the development of the steamship were continually on the look-out for a more efficient means of propulsion.

The paddle steamers of those days were small, and in a heavy beam wind were liable to heel over so far as to bury the paddle on one side far below its efficiency point, while the paddle on the other side was half out of the water. An amusing story is told of the days, towards the end of the 19th century, when the St. George Company and the Isle of Man Steam Packet Company were competing desperately for the passenger traffic between Liverpool and the Isle of Man. The "*St. George*," belonging to the former company, and the "*Mona's Isle*," owned by the latter, were to sail at the same time on a certain morning. On the previous day a strong wind was blowing, and the captain of the "*Mona's Isle*," confident that this wind would prevail next day, had the cargo and coal shifted to the windward side of his vessel during the night. On the following morning the "*St. George*" steamed out of the Mersey in perfect trim, whereas the "*Mona's Isle*" heeled over to such an extent as to cause general astonishment and amusement. As soon as the protection of the land was lost, however, the "*St. George*" heeled over before the strong wind, while the "*Mona's Isle*" went ahead on an almost even keel with both paddles working at their maximum efficiency, so that she soon outstripped her rival.

Screw propulsion as an alternative to the paddle wheel had been considered for many years, but the early experimenters, though full of sound ideas, did little to put forward practical schemes. It was not until 1836 that really serious efforts were made to apply the screw to steam vessels. In that year experiments that had far-reaching results were carried out by Francis Pettit Smith. Smith was born in 1808 at Hythe, in Kent, where his father was Postmaster, and as a boy he was passionately fond of constructing models of boats. When he grew up he became a farmer on Romney Marsh, and afterwards moved to Hendon, where the reservoir of the old Welsh Harp provided him with an ideal water on which to try out his boats. In 1834 he built a tiny vessel propelled by a wooden screw driven by a spring, and the performance of this convinced him that the screw was far more efficient than the paddle wheel. He received financial assistance, and during the next few years he carried out a series of successful experiments with a small steam vessel fitted with a wooden screw.

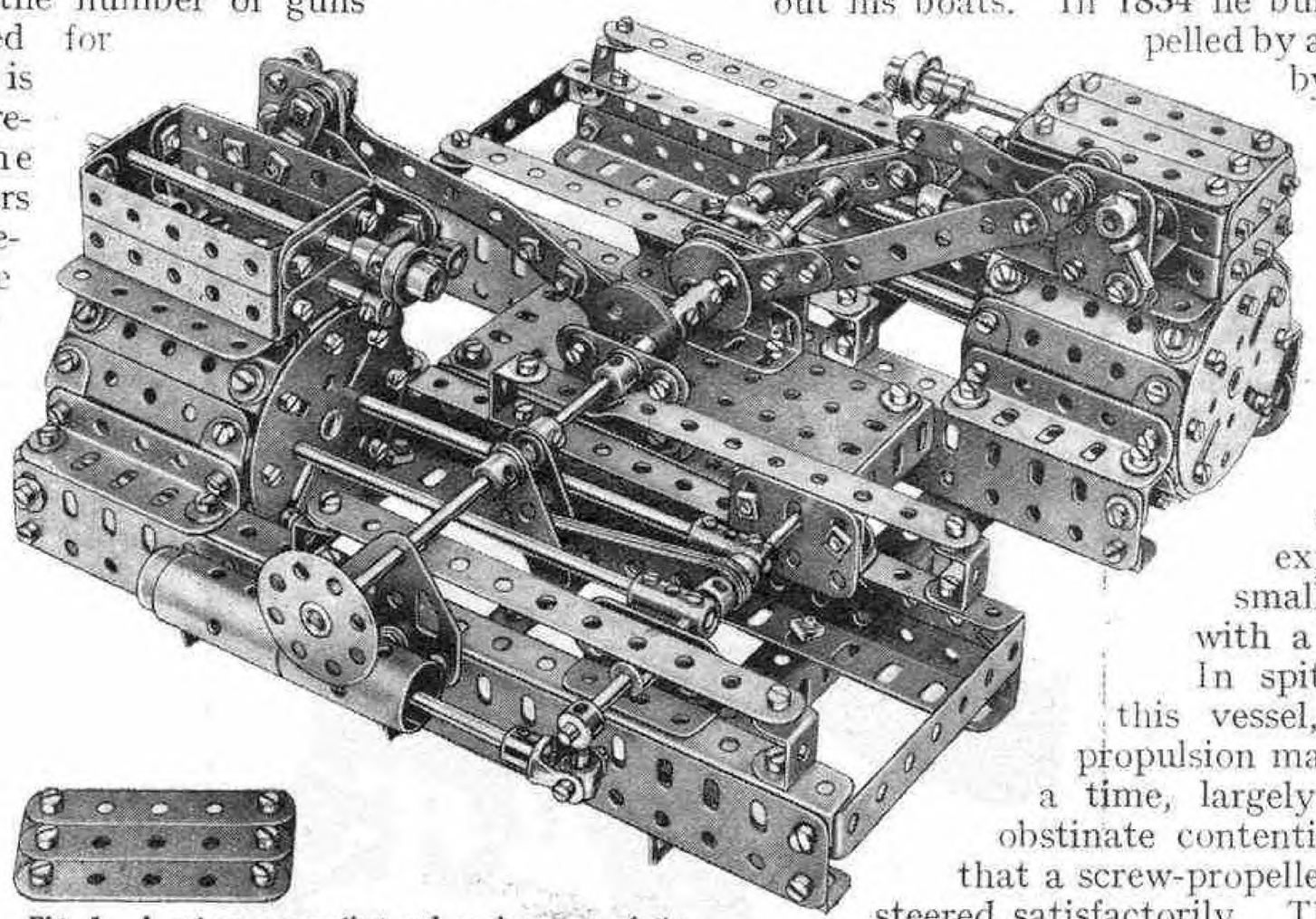


Fig. 1. A return connecting rod engine, one of the earliest high-speed screw engines.

In spite of the success of this vessel, the idea of screw propulsion made little headway for a time, largely on account of the obstinate contention of Naval officials that a screw-propelled vessel could not be steered satisfactorily. The superior efficiency of the screw could not long be denied, however, and after about 1860 screw propulsion became practically universal, both for merchant and Naval vessels.

Another pioneer of screw propulsion, Captain J. Ericsson, a Swede, must be mentioned. He was in England at the time when Smith took out his patent, and was then perfecting a propeller of his own. He built a boat 40 ft. in length fitted with two propellers, which proved very successful. He invited the Admiralty to see it, but they turned it down, as they had turned down Smith's invention, "because it would be absolutely impossible to make the vessel steer." After this rebuff Ericsson went to the United States, where he succeeded in interesting the Government in his propeller, but without gaining much reward for his labour.

The early screw engines were practically the same as the paddle engines, with the exception that, owing to the higher shaft speeds that were necessary, gearing had to be employed. The "*Great Britain*," for instance, the first screw steamer to cross the Atlantic, was fitted with oscillating engines arranged to drive a large spur wheel that engaged with a spur pinion on the propeller shaft. For the first few years after the introduction of the screw no new type of engine was developed, those employed being adapted beam, side lever, and oscillating engines.

When the problem became better understood, however, engineers began to abandon geared engines altogether in favour of properly designed quick-running, direct-acting engines. These engines were lighter, and considerably less bulky, and generally were more efficient on account of their higher piston speeds.

One of the great difficulties that the engineers were faced with at this time was the length of the connecting rod necessary for economical working; and as the vertical type of multi-cylinder engine had not yet been designed, this proved a difficult problem. It was overcome in various ways, the earliest success being the return connecting rod engine, a type that was widely used up to the close of last century in both commercial and Naval steamships. A model of an engine of this type is shown in Fig. 1, which is a scale reproduction of the engine fitted into the British frigate "*Amphion*" in 1844. This was the first engine of the type to be built, and for this reason it is particularly interesting.

The complete power unit is built up as two single cylinder engines, each cylinder being composed of two Face Plates secured together by seven $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. The spaces between these Double Angle Strips are filled in by means of $2\frac{1}{2}''$ Strips held in place by Flat Brackets. Two $2\frac{1}{2}''$ Angle Girders, fitted as shown, are used to secure the cylinder to the two side members, each of which is built up from two $9\frac{1}{2}''$ Angle Girders and one $9\frac{1}{2}''$ Flat Girder. The two members are connected together at their unsupported ends by a $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. The two piston rods, $6\frac{1}{2}''$ Rods, are coupled to the crosshead by Couplings, the crosshead being built up from a $4\frac{1}{2}''$ Rod and two slides held in place by Double Arm Cranks. Each slide is represented by a $1\frac{1}{2}''$ Flat Girder and two $1\frac{1}{2}''$ Angle Girders.

One end of the crosshead rod overlaps the outer side-member supporting the cylinder, and carries a Swivel Bearing to which is attached the condenser pump rod. The connecting rod is supported on the crosshead rod between two Collars and is attached to the crank by means of a $\frac{3}{8}''$ Bolt. The valve chest, the cover of which is shown in the bottom left-hand corner of Fig. 1, is fitted with two valves, one hand operated for starting, and the other by an Eccentric on the crankshaft. It should be noted that the hand-operated valve and its actuating lever are dummies, but the valve operated from the crankshaft is coupled up as indicated.

When the two cylinder units are complete they are secured together by three $9\frac{1}{2}''$ Angle Girders, and a $4\frac{1}{2}''$ Flat Plate is fitted as shown to form an operating platform from which, in actual practice, the engine is controlled.

We now come to a period when a vast amount of experimental work was carried out by both engineering firms and private individuals, the result of which was the production of a great variety of marine engines, each claiming some special advantage. These engines, however, with one exception, were all direct-acting, and fitted with piston rods and connecting rods. The exception was an engine built by Captain Ericsson, mentioned earlier in this article, and it was designed with the object of reducing the mass of moving parts. It was operated by two rocking segments working in specially-designed cylinders, the vibrations thus set up being transmitted through a series of long and short cranks to the propeller shaft. The air pump and other auxiliaries were driven from the first stage of vibrating cranks. Although this type of engine was effective in operation, it became obsolete as workmanship improved and it became possible to attain the necessary balance to enable great masses of metal in the moving parts to work in absolute safety even at very high speeds.

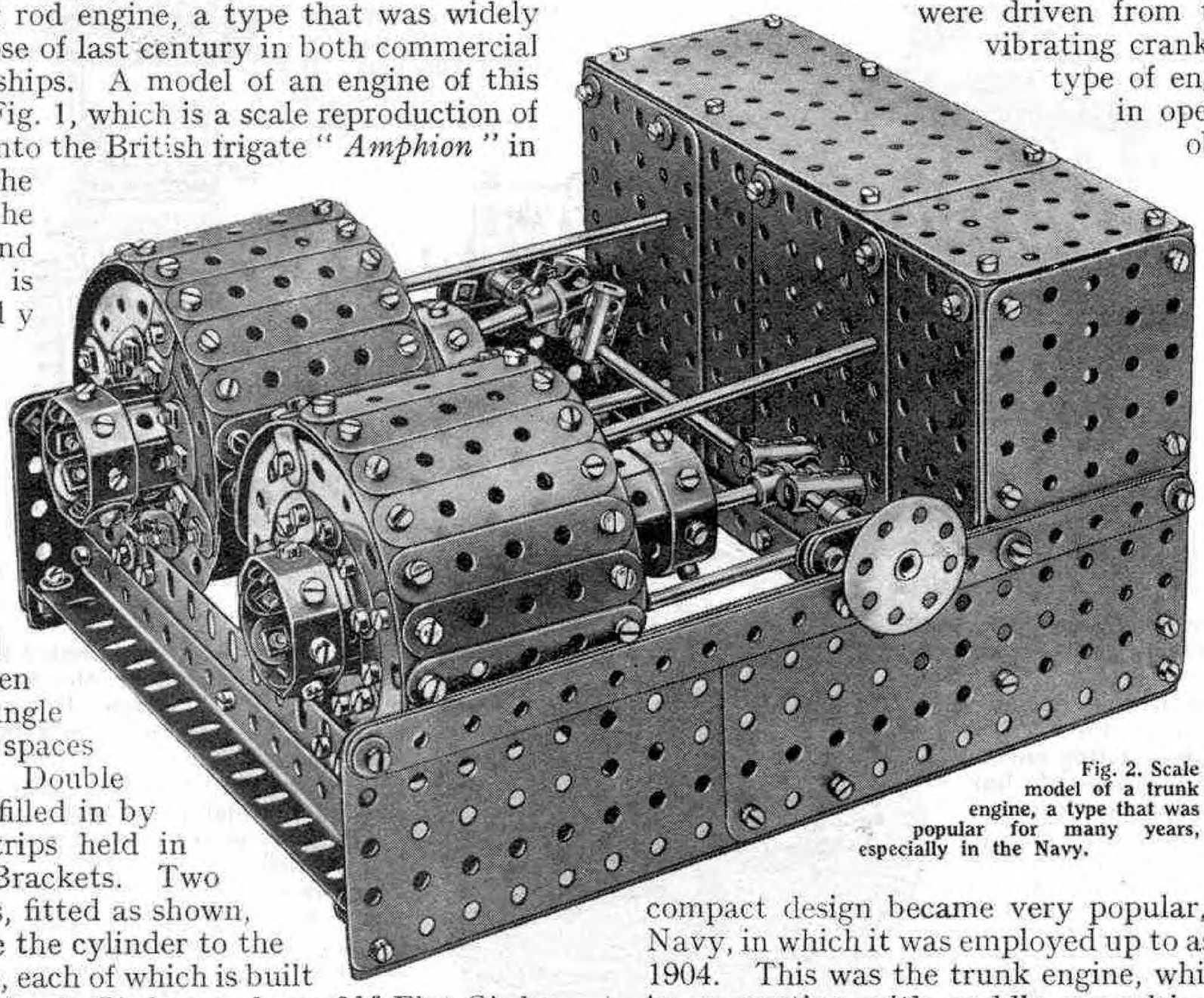


Fig. 2. Scale model of a trunk engine, a type that was popular for many years, especially in the Navy.

Another type of engine came to the fore at this period, and on account of its low centre of gravity and compact design became very popular, especially in the Navy, in which it was employed up to as recently as about 1904. This was the trunk engine, which was mentioned in connection with paddle propulsion in the previous article.

The trunk engine is shown in model form in Fig. 2. Each fore and aft side member of the main frame is built up from a $7\frac{1}{2}''$ Angle Girder and a Flat Girder of similar length, the two complete sides being connected together by two end girders built up from $9\frac{1}{2}''$ Angle Girders and Strips and $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates. The condenser is composed at each long side of $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates bolted to $7\frac{1}{2}''$ Angle Girders and the top and ends are represented by $5\frac{1}{2}'' \times 2\frac{1}{2}''$ and $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates. Angle Girders of suitable lengths add strength to the structure.

The ends of the cylinders are built up from $2\frac{1}{2}''$ small radius Curved Strips and Flat Brackets, these latter parts being arranged on the inside of the circle formed by the Curved Strips, as shown in the photograph. The complete cylinder ends are secured together in pairs by means of $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, and one of these holds the cylinder walls in place. The walls are made detachable and are represented by two pairs of $3\frac{1}{2}''$ Strips joined together and curved as shown, and fitted with twelve $2\frac{1}{2}''$ Strips. The complete walls must not be fitted until the trunk is in position. The trunk is composed of two $5\frac{1}{2}''$ Strips, bent until they form two circles, and round the inside of these are bolted ten $4\frac{1}{2}''$ Strips. These are secured in place alternately, so that when the edges of the Strips overlap they do so without allowing

the bent 5½″ Strips to lose their true shape. The trunks are placed inside the cylinders before one of their respective end 5½″ Strips is fitted in place.

The little-end of each cylinder, a Small Fork Piece, is mounted on a 1½″ Rod in the centre of the trunk, and the connecting rod is held at its inner end by this. At its outer end it is secured by a second Small Fork Piece to a 1″ Rod forming the connecting pin between the two webs of the Crank. The crankshaft is built up as illustrated and its two main end bearings are each formed from a 1½″ Flat Girder and a Double Arm Crank.

The pump rods, four in number, are represented by 6½″ Rods, and are attached to the trunks by means of ½″×½″ Angle Brackets, Collars being used to prevent the Rods moving longitudinally. It will be noticed that no valve-gear is fitted, this being missed out because of its compli-cated nature, and also because of the small scale to which the model is built.

Although the propeller is now screw pro-all ordinary steam-universal for ships, paddle wheels are still employed in special types of vessels intended for use on rivers and other shallow waters. The engines usually fitted to these vessels are direct-acting, inclined-cylinder, compound units, low-built and remarkably efficient. In cases where it is necessary to manœuvre the vessel by varying the speed of the paddles in relation to one another, two separate engines are fitted.

A modern type of paddle engine is shown in model form in Fig. 3, this being a compound, direct acting engine, fitted with the usual Stephenson's link motion. The main longitudinal framing is composed of two channel section girders, each of which is built up from one 18½″, one 7½″, one 5½″, one 4½″ and one 3½″ Angle Girders, all held together by two 12½″ Flat Girders to form a compound girder 15½″ in length. The 4½″ Angle Girder, placed at one end of the channel section girder, is secured in place at an angle in order to give the cylinder block the required tilt.

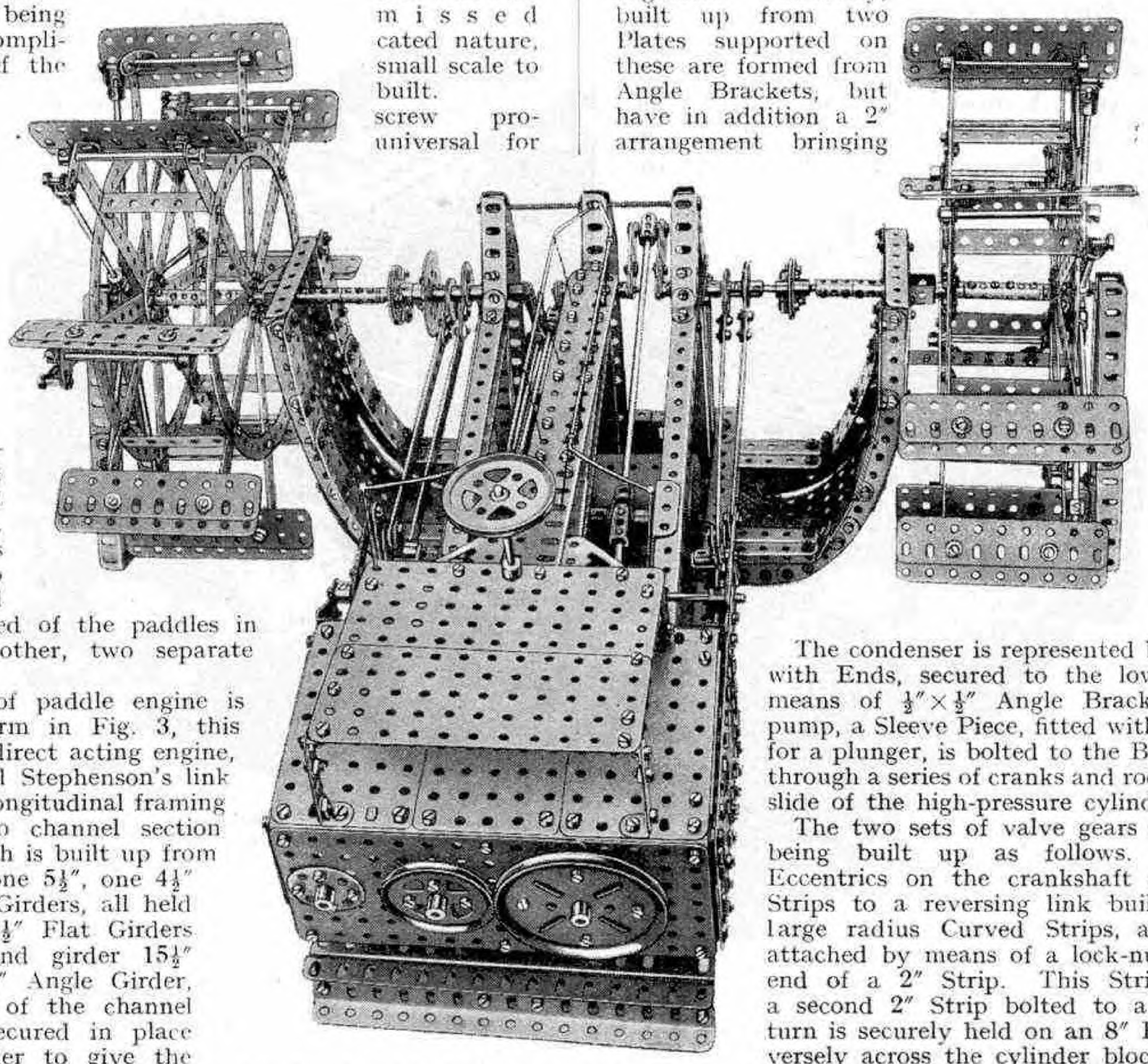


Fig. 3. A model of a modern paddle engine, illustrating the compact arrangement of a marine power unit of this type.

When the two main girders are completed they are secured together by means of two "I" section girders, each of which is built up from 7½″ Angle Girders and 7½″ Flat Girders, Simple Bell Cranks being used to give strength to the complete frame. The fore end of this frame is secured to a specially shaped structure representing a section of the hull of the vessel. This is built up from a number of 5½″×3½″ Flat Plates, bent to the required shape and held in this form by suitable Curved Strips and two 9½″ Angle Girders, these two latter parts being bolted across the bottom of the "hull." Flat Girders and Angle Girders are now used as shown in the photograph in order to give a substantial appearance to the Curved Strips and 9½″ Angle Girders.

The cylinder block is built up from 5½″×3½″ and 4½″×2½″ Flat Plates, 7½″ and 3½″ Angle Girders holding them rigidly together. One of the two sides of this unit is built up from two 4½″×2½″ Flat Plates, the securing nuts being placed on the outside of the finished cylinder block, giving the impression of a slide-valve chest cover. The other side of the cylinder block does not carry the nuts outside, as the valve at this point is one of the ordinary piston type. The cylinder heads of the low-pressure and high-pressure cylinders are represented by 2″ and 3″ Pulleys respectively.

The crankshaft bearing supports, three in number, are each built up from a Flanged Sector Plate fitted at each side with a 5½″ Angle Girder by means of which the Sector Plate is secured to the main frame. The upper ends of the Sector Plates are finished off as shown by 2½″ Angle Girders, and are held in place by means of Flat Brackets bent to the required shape. The crankshaft bearings are represented by pairs of Double Arm Cranks.

The slide bars, which also form the upper bracing members of the engine, are built up from 9½″ Angle Girders. The inner slide bar, which is double, takes the shape of an "I" section girder, and the two outer ones are constructed in the form of channel section girders. ½″×½″ Angle Brackets are used to attach these slide bars to the cylinder block and main bearings. Each of the crossheads is built up from 1½″ Angle Girders and a 2″ Threaded Rod, an 8″ Rod being used as a connecting rod and a 4½″ Rod as a piston rod. The construction of the cranks is shown in the photograph.

The top of the engine is fitted with a control platform and engineers' footway, the platform being built up from two 5½″×2½″ Flat Plates supported on four legs. Two of these are formed from 1″×½″ and ½″×½″ Angle Brackets, but the remaining two have in addition a 2″ Strip each, this arrangement bringing the platform almost level. The engineers' gangway is composed of two 9½″ Flat Girders supported at the opposite end to the platform by a 1″×½″ Angle Bracket. The handrails are built up from Healds and lengths of Spring Cord down the centre of which is passed 26 S.W.G. copper wire in order to hold the complete handrail comparatively rigid.

The condenser is represented by a Boiler, complete with Ends, secured to the lower main girders by means of ½″×½″ Angle Brackets. The condenser pump, a Sleeve Piece, fitted with a Chimney Adapter for a plunger, is bolted to the Boiler, and is actuated through a series of cranks and rods from the crosshead slide of the high-pressure cylinder.

The two sets of valve gears are now fitted, each being built up as follows. Two single throw Eccentrics on the crankshaft are coupled by 7½″ Strips to a reversing link built up from two 2½″ large radius Curved Strips, and this is pivotally attached by means of a lock-nutted ⅜″ Bolt to one end of a 2″ Strip. This Strip is lock-nutted to a second 2″ Strip bolted to a Crank, and this in turn is securely held on an 8″ Rod supported transversely across the cylinder block by two 1½″ Strips held in place by means of Trunnions. The centre of this Rod is fitted with a Double Arm Crank carrying a Small Fork Piece that is rigidly secured to the Crank by a Nut and Bolt. The threaded bore of the Small Fork Piece carries a 2″ Threaded Rod coupled by means of a Threaded Coupling to a 2½″ Rod. This Rod carries the 2″ Pulley shown in the illustration.

The construction of the paddles was fully described last month in connection with the older types of paddle engines and therefore need not be described again in this article. The construction of the couplings forming a connection between the crankshaft and paddles is shown in the illustration, and the 2″ Sprocket Wheel situated close to one of these is added in case it is desired to drive the model from a Meccano Electric Motor.

If a Motor is to be included in the model, it may be placed on short Angle Girders over the condenser and fitted with sufficient gearing to allow the paddles to rotate at about 50 r.p.m. This is not only the speed generally adopted in actual practice, but also it allows the working parts of the model to be clearly understood when it is in motion, the feathering paddle wheels being particularly interesting from this point of view.

The most important of the well-known early marine engines have now been described, the last example, a trunk engine, bringing us to the close of the nineteenth century, when the introduction of the vertical steam hammer type of engine revolutionized marine practice and brought about the commencement of the craze for higher speeds. A selection of models of these later types of engines will be dealt with next month, and the introduction and general operation of compound and tandem engines will be described.

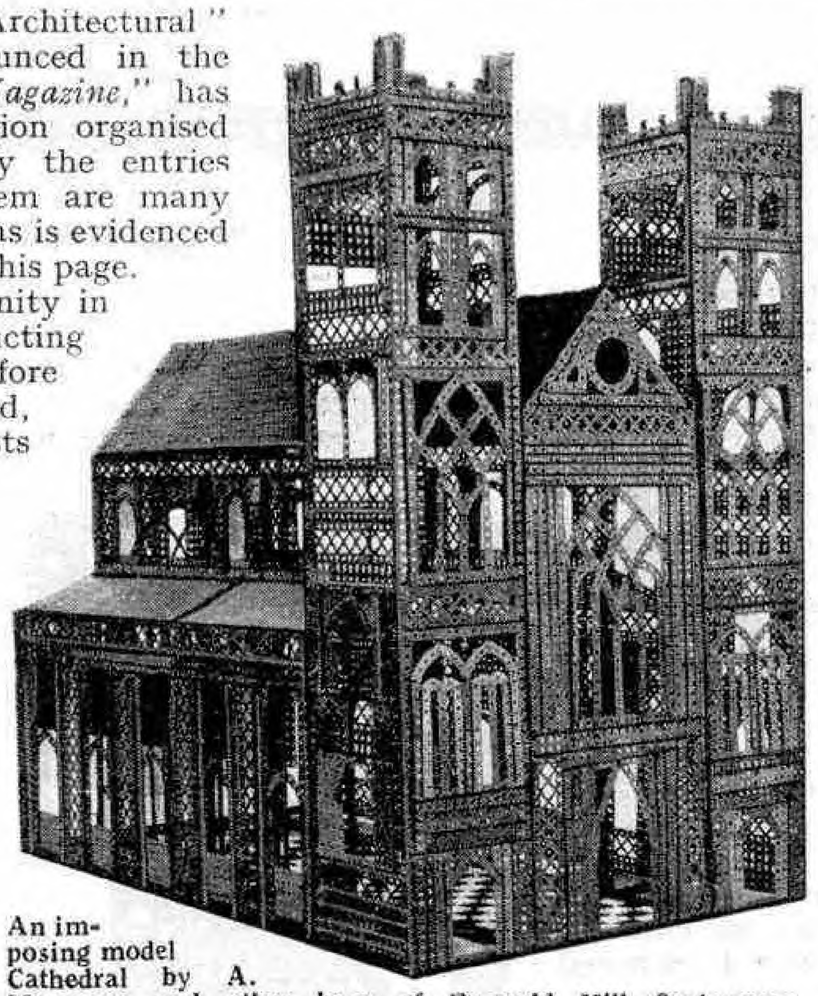
Model-Building Contest Results

By Frank Hornby

Second "Architectural" Competition

I am glad to say that the Second "Architectural" Model-Building Contest, which was announced in the November 1933 issue of the "*Meccano Magazine*," has proved to be the most popular competition organised for some time. In Section B particularly the entries show surprising ingenuity, and among them are many models of considerable architectural beauty, as is evidenced by the two splendid examples illustrated on this page. Model-builders have not had much opportunity in the past for exercising their ability in constructing competition models of this kind. I am therefore specially pleased with the fine results obtained, and I intend to arrange further similar Contests in future.

It was a most difficult job to pick out the prizewinners, for so many of the entries appeared of almost equal merit. However, it was decided ultimately to award the principal prizes to the competitors named in the following list. It will be remembered that Section A was reserved for models built from Outfits not larger than No. 3, and Section B for models built from Outfits Nos. 4–7.



An imposing model Cathedral by A. Musgrave and other boys of Emerald Hill Orphanage, Salisbury, Rhodesia.

Section A

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: J. Goss, Exeter. SECOND PRIZE, No. 3 Kemex Outfit: R. Bahadur, Delhi, India. THIRD PRIZE, No. 2 Kemex Outfit: L. Harman, London, S.E.13. FIVE PRIZES of No. 1 Kemex Outfits: G. Endacott, Plymouth; L. Slater, Portsmouth; J. Whitaker, Cambridge; A. Fulcher, Te Kuiti, New Zealand; Heng Geok Kim, Singapore, S.S.

Section B

FIRST PRIZE, Meccano or Hornby Goods value £3-3s.: D. Holloway, Squirrels Heath. SECOND PRIZE, Goods value £2-2s.: J. Willems, Antwerp, Belgium. THIRD PRIZE, No. 2 Elektron Outfit: A. Musgrave, Salisbury, Rhodesia. TEN PRIZES of No. 1 Elektron Outfits: H. Cunningham, Belfast; A. Glossop, Chorley; M. Hodder, Exeter; K. Merton, London, S.E.12; W. Pegum, Ballylongford, Co. Kerry; H. Spanswick, London, S.E.12; H. Thomas, Cardiff; N. Paola, Durban, S. Africa; M. Roche, Paris; E. Shalom, Basra, Mesopotamia.

The first Prize model in Section B is the splendid replica of the Cenotaph War Memorial illustrated here. In my opinion this is one of the most realistic prize models that have ever been illustrated in the "*Meccano Magazine*," and I am sure that anyone who has seen the actual Cenotaph in Whitehall, London, will appreciate the merit of the model. The builder has been entirely successful in obtaining simplicity of construction combined with the majestic appearance that is probably the principal feature of this impressive monument.

The stone wreaths that appear on the actual monument are represented in the model by Meccano 3" Dunlop Tyres, and these play a big part in producing the realistic appearance of the completed model. The various mouldings above and below the wreaths are represented by two 1½" Strips each fitted with a ½" loose Pulley at one end, and different sized Axle Rods secured in Collars or Couplings fastened to the side of the monument. Holloway built the model soon after the Cenotaph was erected, and he originally painted it with white distemper in order to make it a closer reproduction of the prototype. The effective result obtained will be evident from the illustration. I am informed that the distemper has since been washed off, leaving the Meccano parts uninjured. Congratulations are due to Holloway on his good work in so skilfully reproducing this fine memorial to those who fell in the Great War.

The other model illustrated on this page represents a cathedral, and was built by Anthony Musgrave, with the assistance of other boys of Emerald Hill Orphanage, Salisbury, Rhodesia. This model is of course a much more massive structure than the Cenotaph model, and is a really splendid attempt to capture the appearance and grandeur of an English cathedral. The model lacks the neat and solid appearance of the Cenotaph, but allowance must be made for the difficulty of filling in big spaces when only a limited stock of parts are available.

Undoubtedly the finest feature of the model is the construction of the arched windows, in the making of which combinations of Curved Strips have proved useful. Another feature is the good proportion between the towers and the various parts of the building. Readers may be interested to know that the boys of the Emerald Hill Orphanage have been busy constructing models of this type for some time, and in future issues of the "*M.M.*" I intend to illustrate one or two more of their efforts in this connection.

The model that won success for J. Willems is a reproduction of the facade of a modern Belgian church. It is about 5 ft. 10 in. in height, and 3 ft. 3 in. approximately across the base, and was built with a No. 7 Meccano Outfit. It is not intended to represent a particular building, and is therefore a remarkable demonstration of the constructor's creative powers. To appreciate the full merit of this model illustrations are necessary, and I have decided to deal with it fully in a future issue of the "*M.M.*"

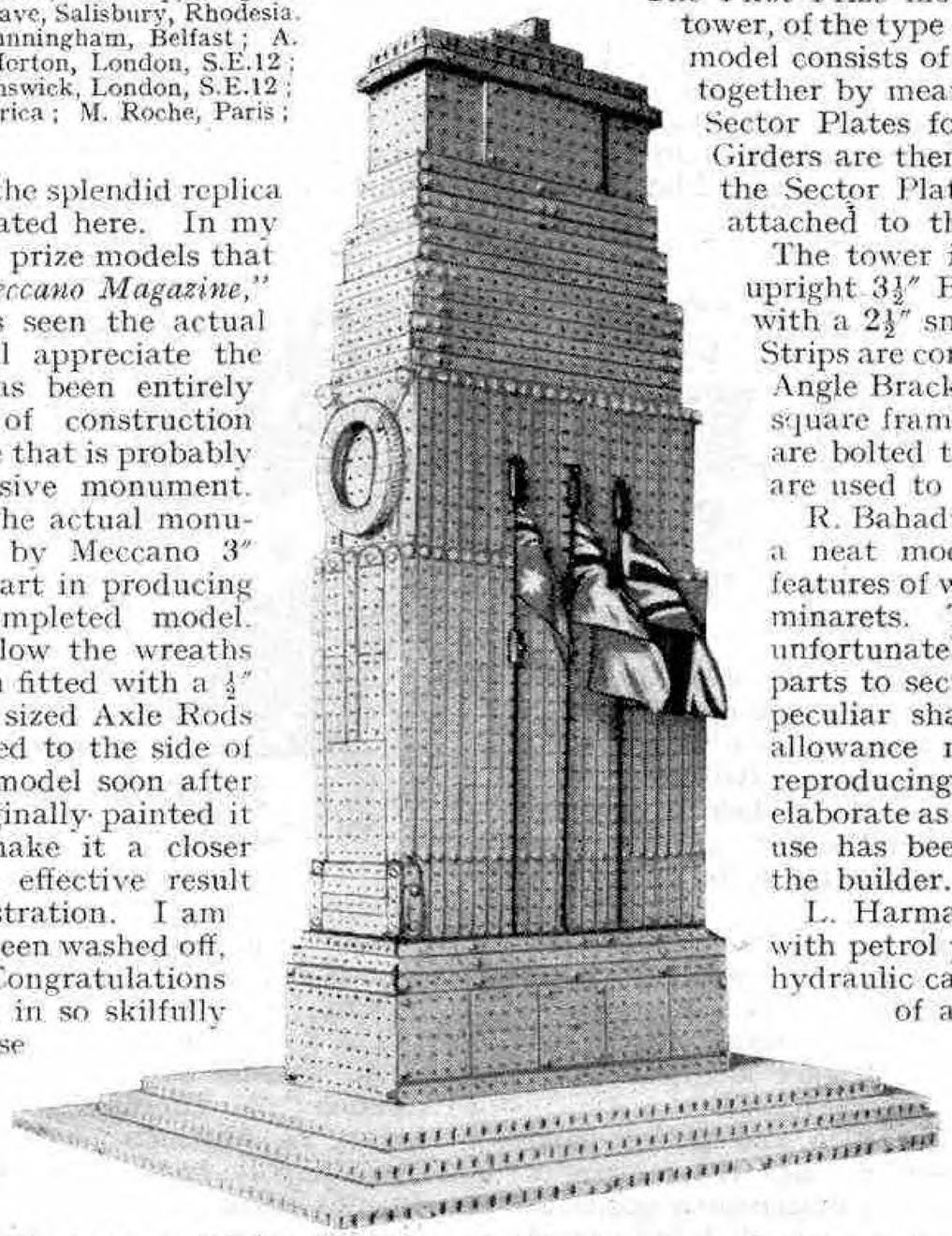
The First Prize model in Section A is a buttressed clock tower, of the type often seen in big cities. The base of the model consists of four Flanged Sector Plates, connected together by means of Strips in such a manner that the Sector Plates form the four arms of a cross. Angle Girders are then bolted vertically to the inner ends of the Sector Plates, and Strips of suitable lengths are attached to them to form the walls of the tower.

The tower is capped by a dome made from four upright 3½" Braced Girders, each of which is fitted with a 2½" small radius Curved Strip. The Curved Strips are connected at their upper ends by means of Angle Brackets and the dome is then attached to a square frame of 3½" Strips, at the corners of which are bolted two vertical 2½" Strips. Curved Strips are used to make frames for the clock dials.

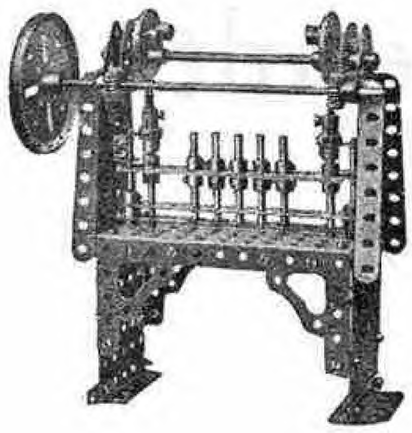
R. Bahadur went to considerable trouble to build a neat model of an Indian mosque, the chief features of which are three domes and two very tall minarets. The domes are made from Strips and unfortunately it was found necessary to bend the parts to secure the desired effect. In view of the peculiar shape of Eastern domes, however, due allowance must be made for the difficulty of reproducing them correctly. The model is not so elaborate as some others in Section A, but very good use has been made of all the parts available to the builder.

L. Harman's entry is a model garage complete with petrol pumps, mobile breakdown crane and a hydraulic car lift. The base of the garage consists of an oblong frame made by spacing two 12½" Angle Girders by means of two 3½" Double Angle Strips. At the corners of this frame are then bolted 5½" Strips, which are connected in pairs by 2½" × 3½" Flanged Plates.

Two 12½" Angle Girders are bolted perpendicularly at points 3" from each end of one (*Continued on page 386*)



The Cenotaph, Whitehall, London, admirably reproduced in Meccano by Derrick Holloway, Squirrels Heath.



Suggestions Section

Edited by "Spanner"

(308)—Pistol (R. Jenks, London, N.19)

The model illustrated in Fig. 308 can be made to fire caps, a roll of which is accommodated inside the pistol. Fig. 308a shows the pistol with one of the sides removed to reveal the operating mechanism. The two sides each consist of one 5½" Flat Girder to which a 4½" Flat Girder is bolted, and at right angles to these is a 3"×1½" Flat Plate. Channel section girders formed from Angle Girders are bolted round the edges as is shown in Fig. 308a, and the front of the model is filled in with Double Brackets.

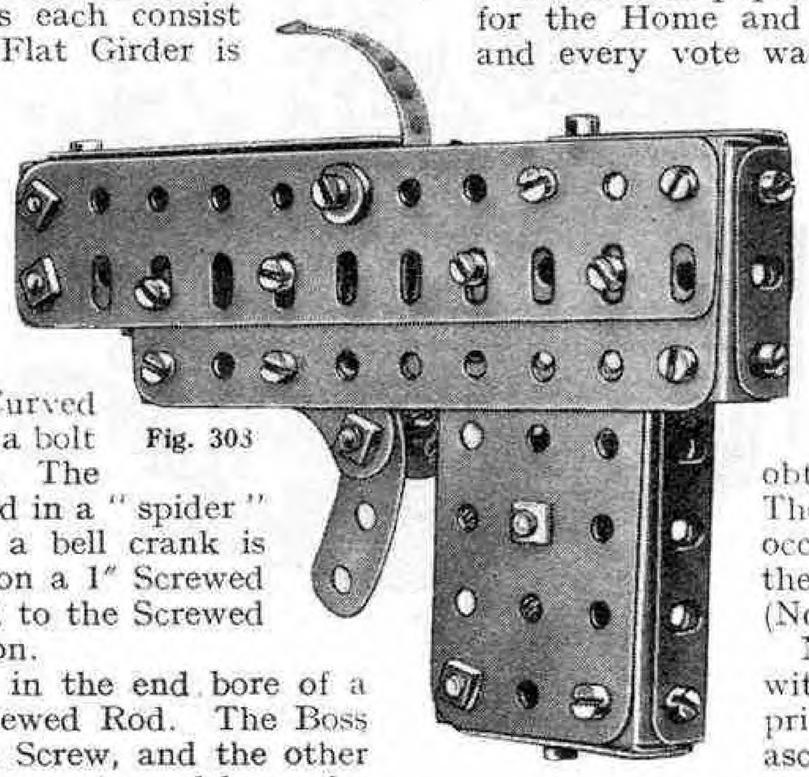


Fig. 303

The trigger 1, consisting of a 2½" large radius Curved Strip, is pivoted in its centre hole on a 1" Screwed Rod. A 2½" Strip is pivoted to the upper end of the Curved Strip, and the other end of this Strip carries a bolt that is inserted in the tapped bore of a Collar. The Collar is firmly gripped by a ½" Bolt inserted in a "spider" carrying the ⅜" Bolt 2. In this manner a bell crank is formed, the "spider" being free to pivot on a 1" Screwed Rod. A length of Spring Cord 3, attached to the Screwed Rod, pulls the trigger into the normal position.

The hammer 5 consists of a bolt fitted in the end bore of a Threaded Boss that is carried on a 1" Screwed Rod. The Boss is locked in position on the Rod by a Set Screw, and the other end of the Rod is inserted in the end transverse tapped bore of a Threaded Coupling and is locked in place by a Set Screw. A ⅜" Bolt is passed through one of the holes in the right-hand side of the gun, and is fitted with a nut before being screwed into the centre transverse tapped bore of the Coupling. The nut is locked against the side of the Coupling to fix the Bolt securely, but sufficient play is allowed for the Bolt to pivot in the Flat Girder. In its end bore the Coupling carries another ⅜" Bolt 4, and in the position shown in Fig. 308a this bolt rests against the head of the ⅜" Bolt 2. The Spring 6 is attached to the Set Screw fitted in the Coupling and to a ⅜" Bolt at the base of the handle of the gun. A ½" loose Pulley is secured in position as shown to keep the Spring clear of the mechanism.

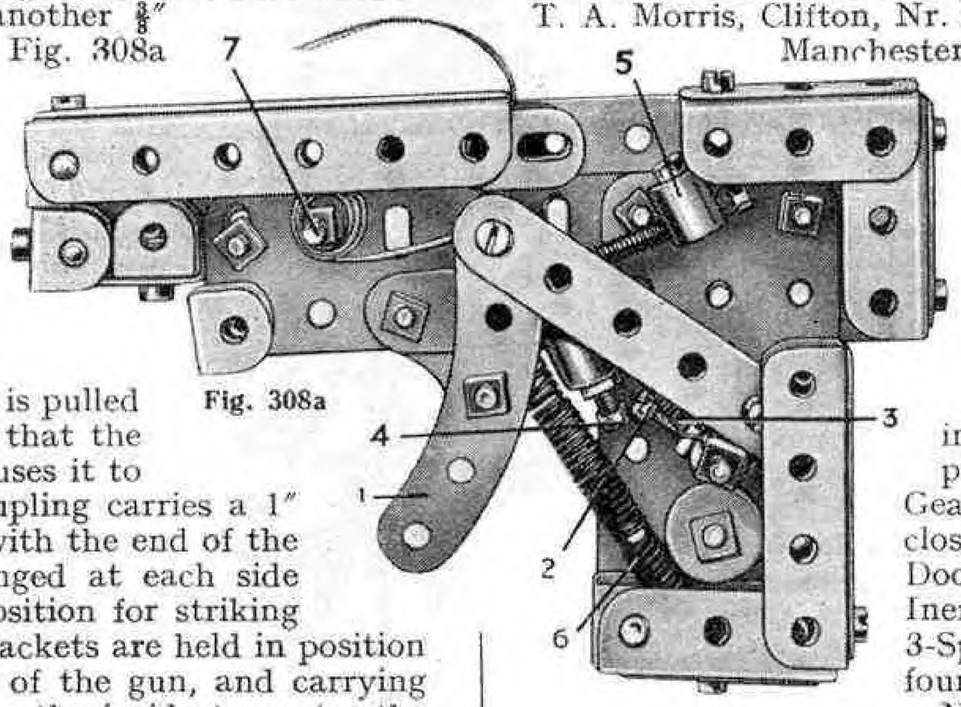


Fig. 308a

In the lower illustration the hammer is shown drawn back ready for firing. When the trigger is pulled, the ⅜" Bolt 2 is pulled out of engagement with the Bolt 4, so that the hammer is released and the Spring 6 causes it to strike the end of a Coupling. The Coupling carries a 1" Screwed Rod the end of which is level with the end of the Coupling, and a Flat Bracket is arranged at each side to guide the hammer into the exact position for striking the cap. The Coupling and the Flat Brackets are held in position by a ⅜" Bolt passed through each side of the gun, and carrying two Washers on the outside and two on the inside to centre the Coupling.

A roll of caps is placed on the ½" Bolt 7, and the caps are fed up between the two Flat Brackets so that they rest against the Coupling ready to be struck by the hammer 5. It will be found necessary to file the bolt head slightly so that it rests flush against the Coupling. As each cap is fired the trigger is drawn back by hand and the next cap pulled up into position.

The pistol should first be built as in Fig. 308a, and the left-hand side built separately and bolted in position when the remainder is complete. Where the fixing bolts are in inaccessible positions for nuts to be placed on the inside, ¾" Bolts are used, being passed through both sides and fitted with nuts outside.

Suggestions Voting Contest Results

Below are published the results of the Suggestions Voting Contest announced in the January "*M.M.*" to ascertain which were the most popular suggestions published during 1933. Entries for the Home and Overseas Sections were treated separately, and every vote was recorded according to its position on the competitor's list. The points allotted to each suggestion in this manner were totalled up at the close of the contest to show which were the four most popular items in each section.

Home Section

In the Home Section the general opinion was in favour of Hobbs Inertia Gear (No. 290) and the Spontan Transmission Gear (No. 297), the former obtaining first place by a very narrow margin. The Combination Safe Door Lock (No. 287) occupied third position in the final list, and the Automatic Opening and Closing Lift Doors (No. 293) the fourth position.

No competitor's list corresponded exactly with the final result of the voting, and the prizes have been awarded to the nearest correct ascertained by a system of points. The winners are as follows: First Prize, cheque for £1-1s.: Kenneth Costain, Bolton, Lancs. Second Prize, cheque for 10/6: J. Mann, Otley, Yorks.

The following competitors each receive a consolation prize: J. C. Button, Crewe, Cheshire; H. Cunningham, Belfast; J. Franklin Anderson, Glasgow, S.E.; J. J. Horne, Moreton-in-Marsh, Glos.; R. H. Sharpe, Surbiton, Surrey; R. Taylor, York; T. A. Morris, Clifton, Nr. Manchester; R. S. Reich, Swinton, Nr. Manchester; T. W. Green, Mapperley, Notts.; P. G. Fishpool, Arundel, Sussex; A. E. Goad, London, S.E.9; D. Whiting, Newport, Mon.

Overseas Section

The result of the voting in the Overseas Section did not coincide with the opinions of Home readers, although the Spontan Transmission Gear and Hobbs Inertia Gear appeared in the final list. In the Overseas Section preference was given to the Spontan Gear (No. 297), which headed the list, closely followed by the Combination Safe Door Lock (No. 287) with the Hobbs Inertia Gear (No. 290) third. The Compact 3-Speed Gear-Box (No. 279) was voted fourth in order of popularity.

No Overseas competitor submitted an all-correct list, so that the prizes have been awarded to the nearest correct. The following are the successful competitors: First Prize, cheque for £1-1s.: J. A. Oleaga, Buenos Aires. Second Prize, cheque for 10/6: J. A. Gnanadurai, Trichinopoly, India.

The following competitors each receive a consolation prize: C. J. McCain, Sydney, N.S.W., Australia; S, Fagerberg, Rappe, Sweden; W. Thompson, Palmerston North, N.Z.; J. Stanbridge, Perth, W. Australia; P. Giese, Buenos Aires; J. G. Gnanadurai, Trichinopoly, India; J. Cesak, Winnipeg, Canada; C. A. Jürgensen, Buenos Aires; A. Carpinter, Christchurch, N.Z.; D. J. White, Roslyn, Dunedin, N.Z.; M. DeLima, Bombay, India; R. Burberry, Lyttelton, N.Z.

(309)—Three-Movement Gear-Box (K. J. McLennan, Cheltenham)

The outstanding feature of the gear-box illustrated in Fig. 309 is that it can be used to provide three movements each of which can be independently stopped, started or reversed. The drive is taken to the gear-box through Sprocket Chain that passes round the Sprockets 1, 2 and 3 in such a manner that the centre Sprocket 2 is driven in the reverse direction to the other two. The Sprockets are each carried on a 2″ Axle Rod fitted with a Collar and ¾″ Pinion. The Collars retain the Rods in place, and the Pinions on the upper and lower Rods are placed close to the outer side plate, whereas the Pinion 4 is arranged nearer the centre of its shaft. Three secondary shafts are arranged as shown, and each carries a 50-teeth Gear Wheel. These shafts are provided with a Collar on one end and at the other end carry two Collars with a space between them to admit the head of a bolt. Three control levers are mounted in small Fork Pieces pivoted on an Axle Rod secured to the base Plates by Handrail Supports. Collars on these levers carry bolts, the heads of which engage the spaces between the Collars on the sliding Rods.

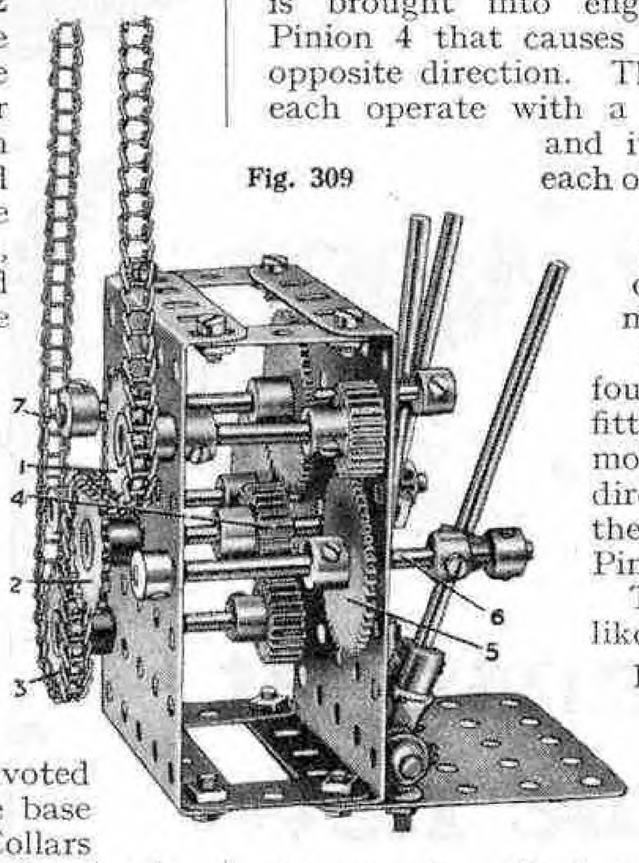


Fig. 309

The method of operation is as follows. The Gear 5 is shown in engagement with the Pinion on the rod of the Contrate 1. By moving the appropriate gear lever over to the left, this Gear is thrown out of mesh with its Pinion, so that no drive is transmitted; and by further movement of the gear lever the Gear is brought into engagement with the Pinion 4 that causes it to rotate in the opposite direction. The other two shafts each operate with a similar movement, and it will be seen that each one can be controlled independently to rotate in either direction or to remain stationary.

If necessary a fourth shaft may be fitted, this being mounted in a position directly opposite to the Rod 7, below the Pinion 4.

This gear-box is likely to be found of particular utility in models of cranes that are provided with travelling, hoisting, luffing and slewing movements. Each movement would be driven from one of the secondary shafts, so that any one movement of the crane could be operated independently of the others, or all could be driven in unsion.

(310)—Spur Differential (S. Williamson, Birmingham)

Most readers are familiar with the principle of the differential gear, one of the main uses of which is to allow for the differences in speed of the driving wheels of a motor car as it takes a corner. The wheel on the inside of the turn follows a curve of smaller radius than does the outer wheel, and consequently does not travel so fast. The differential allows for this while the drive is transmitted to both wheels. The usual Meccano model-building practice in reproducing one of these mechanisms is to employ Bevel Gears, as used in the Meccano Motor Chassis, and an interesting deviation from this practice is shown in Fig. 310. In this case Pinions are used instead of Bevels for the actual differential gear, but the drive from the cardan shaft is taken through Bevels.

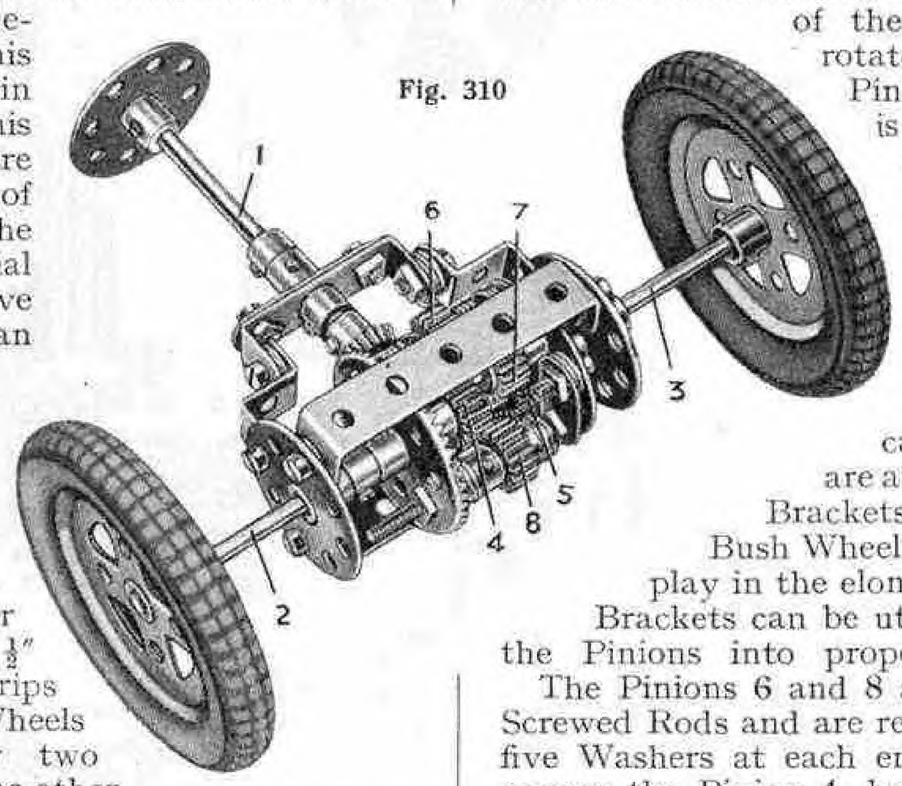


Fig. 310

A casing for the entire unit is built up from two Bush Wheels connected together by two 2½″ × ½″ Double Angle Strips spaced from the Wheels at one end by two Washers and at the other end by one Washer. Two ½″ Reversed Angle Brackets support a 1½″ × ½″ Double Angle Strip that carries a Double Arm Crank forming a bearing for the cardan shaft. The Double Angle Strip is spaced by Washers as shown, so that the ½″ Bevel on the Rod 1 engages properly with the 1½″ Bevel and the Rod 2.

The Rod 2 is inserted through the boss of the Bush Wheel at one end of the casing, and carries a Collar and a 1½″ Bevel that is free on the Rod. The end of the Rod is gripped in the boss of the Pinion 4, spaced from the Bevel by three Washers, but should not occupy more than half of the Pinion bore. The Rod 3 is inserted through the other end of the casing and through a second Bush Wheel that is spaced by two Washers from the fixed Pinion 5. The end of the Rod is free to rotate in the end of the Pinion 4. The Bevel is fitted with two 2″ Screwed Rods, the other ends of which are fixed to Flat Brackets bolted to the Bush Wheel that is free inside the casing. The Rods are attached to the Flat Brackets and not to the Bush Wheel direct, so that the play in the elongated holes of the Brackets can be utilised for bringing the Pinions into proper engagement.

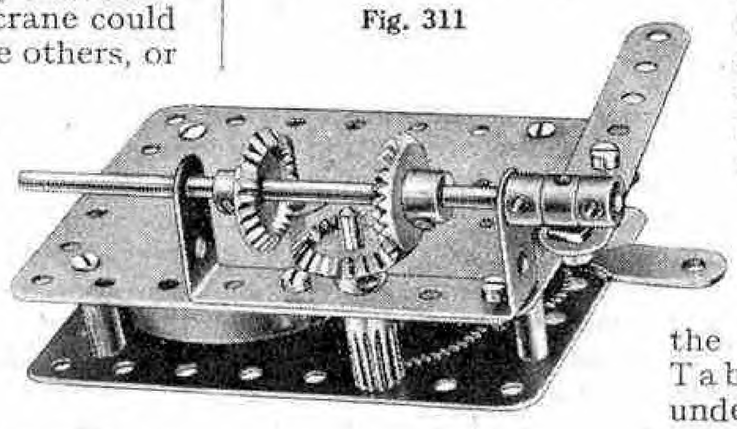
The Pinions 6 and 8 are carried on the Screwed Rods and are retained in place by five Washers at each end. Both Pinions engage the Pinion 4, but are so arranged that only about one third of the entire width is in mesh. The Pinion 7 is carried on a ¾″ Bolt attached to the Bush Wheel, and engages the Pinion 6 and also the Pinion 5. Another Pinion directly opposite to the Pinion 7 engages with the Pinion 8 and the Pinion 5.

Miscellaneous Suggestions

Under this heading "Spanner" replies to readers who submit interesting suggestions regarding new Meccano models or movements that he is unable to deal with more fully elsewhere. On occasion he offers comments and technical criticisms that, he trusts, will be accepted in the same spirit of mutual help in which they are advanced.

(M.171.) Meccanograph Pencil.—An ordinary pencil does not give very satisfactory results when used in the Meccanograph model. A soft lead pencil produces a black line but very soon wears down and becomes too thick for tracing the design, and a hard lead gives a light grey line that does not contrast sufficiently with the paper. These difficulties can of course be overcome by using a fountain pen, but occasions arise when one is not available, or for other reasons it may not be desired to use ink for the design. In such cases the procedure suggested by J. M. Baughan (Harrow), may be adopted. The design is traced with an indelible copying pencil with a hard "lead," and when completed the paper is held over a jet of steam for a while. This process darkens the pencil lines and improves the design considerably.

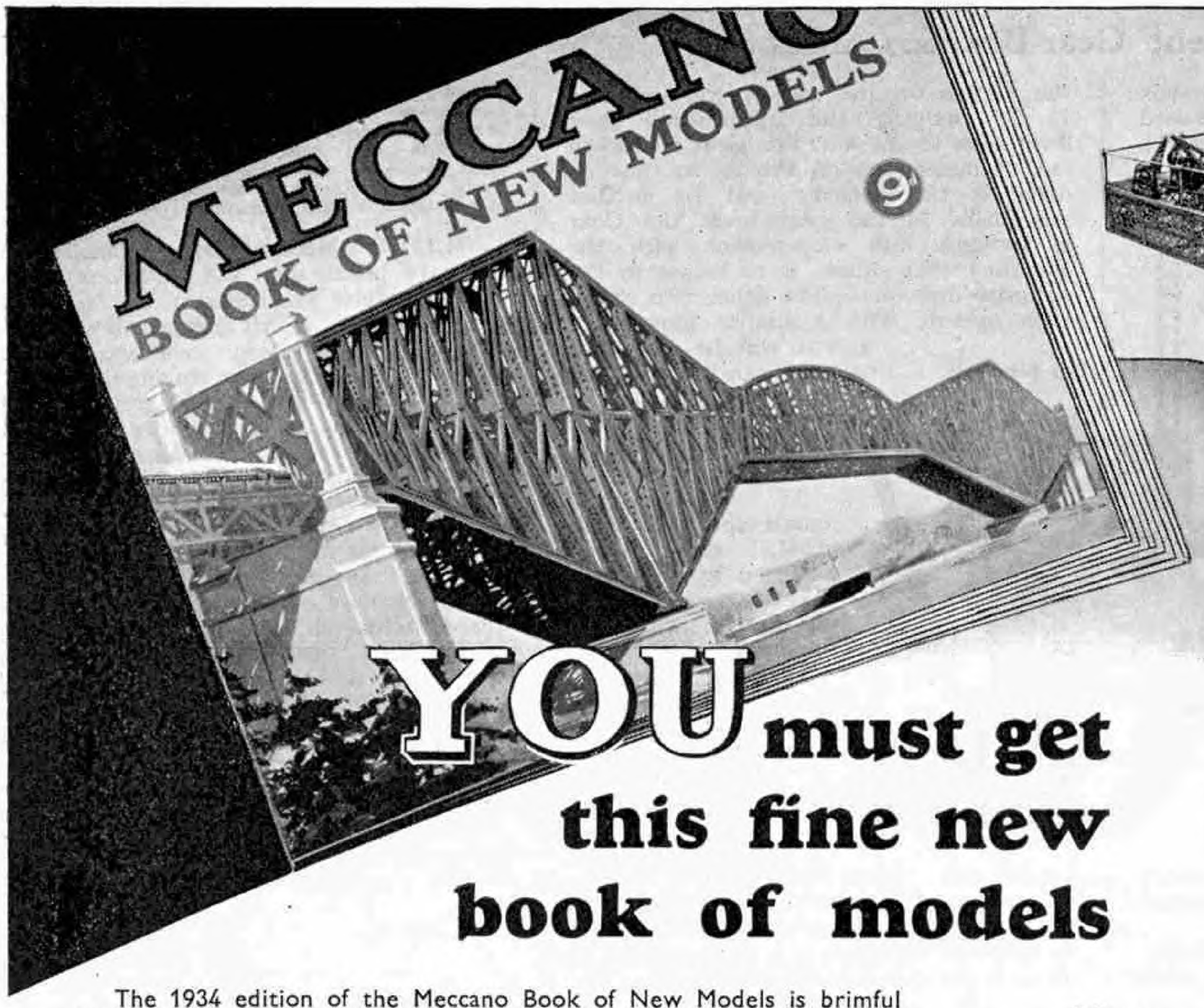
(M.172.) Holding the Paper on the Designing Table.—T. W. Green (Mapperley, Notts.) prefers not to use drawing pins for fixing the paper on the Designing Table, as in time they spoil the surface of the Table, although only the edges are affected. Instead he employs a rubber band that is placed over one corner of the Designing Table, passed underneath, and fitted over the other corner. Thus the rubber band is stretched across opposite corners of the upper surface of the Table, and a piece of paper placed underneath the rubber is held in position. A second band may be added if necessary so that all four corners of the paper are held down.


Fig. 311

(311)—Reverse for No. 1 Clockwork Motor

The simple reversing gear shown in Fig. 311 can be used for many purposes where forward and reverse drive are required, but it will be found particularly useful by those who have No. 1 non-reversing Clockwork Motors. The mechanism consists essentially of three Bevel Gears, one being fitted to the driving shaft and the other two on a sliding shaft and arranged so that either can be meshed with the driving gear.

A 2½″ × 1″ Double Angle Strip is bolted to the Motor side plate and forms a bearing for the sliding Rod. This Rod is fitted with the two Bevels, as shown, that are arranged to mesh alternately with opposite sides of the driving Bevel. On the end of the Rod are three Collars, the centre one being free and carrying a bolt that is prevented from gripping the Rod by a nut locked tightly against the Collar. The bolt forms a pivot for the end of a 3½″ Strip pivoted in its third hole to a ½″ Reversed Angle Bracket. This Strip forms the lever for operating the Gear. The drive is taken from the sliding Rod, and some form of sliding drive may be utilised to allow for the movement of the Rod.



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The principal object of the book is to keep Meccano model-builders in touch with the latest improvements and developments connected with their hobby. Illustrations and details of the best of the new models and new movements submitted in recent competitions, together with many others that have been designed by our own experts are included. The models shown are of outstanding interest and variety.

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HOW TO OBTAIN THE BOOK

The Meccano Book of New Models may be obtained from any Meccano dealer, price 9d., or direct from Meccano Ltd., Binns Road, Liverpool 13, price 10½d. post free. In the latter case a postal order or stamps should be sent, and the name and address of the sender should be clearly written.

OVERSEAS ORDERS

Supplies of the Meccano Book of New Models have been despatched to our colonial agents to fill orders received. The Australian price is 1/9 from dealers, or 1/11 from our agents; the New Zealand and South African price is 1/– from dealers or 1/2 from our agents; and the Canadian 25 cents from dealers or 30 cents from our branch at Toronto. The names and addresses of our agents in these countries are given below. Readers living in countries other than those mentioned should order from Meccano Limited, Binns Road, Liverpool 13, sending a remittance of 1/2 with their orders.

OVERSEAS AGENCIES

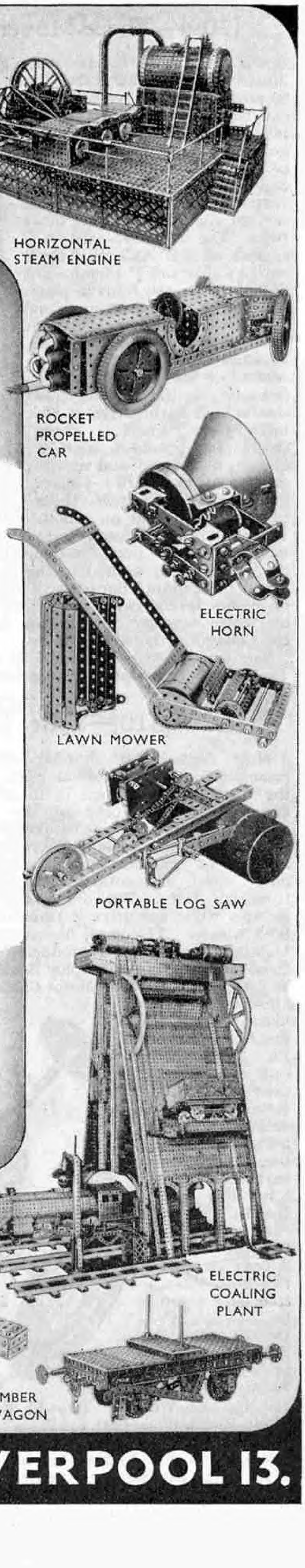
AUSTRALIA: E. G. Page & Co., 52, Clarence St., Sydney (P.O. Box 1832k).
NEW ZEALAND: Models Limited, P.O. Box 129, Auckland C1.
SOUTH AFRICA: Arthur E. Harris, 142, Market Street, Johannesburg (P.O. Box 1199).
CANADA: Meccano Ltd., 34, St. Patrick Street, Toronto.

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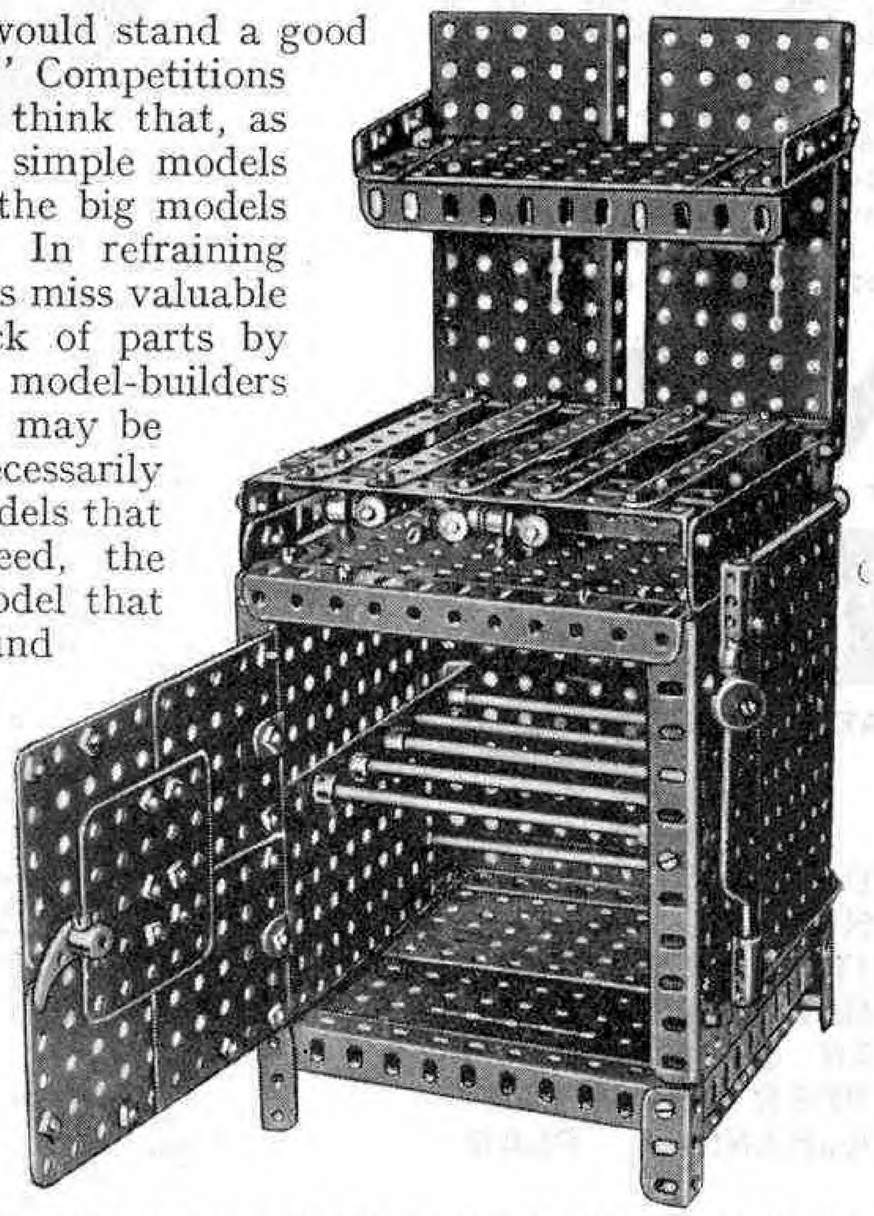
Grand Model-Building Contest

For the Best-Constructed Models of any Type

In this Contest Meccano model-builders of all ages have an equal chance of carrying off one of the fine prizes listed at the foot of this page. All that a competitor has to do is to think of a new model, no matter how simple, and then set to work to build it from standard Meccano parts. Models may be of any type or size, so that competitors have an enormous range of subjects to choose from.

Many clever model-builders who would stand a good chance of winning prizes in "*M.M.*" Competitions do not submit entries because they think that, as they have only small Outfits, their simple models would be completely outclassed by the big models built by boys with large Outfits. In refraining from entering the Contests these boys miss valuable opportunities to increase their stock of parts by winning prizes. We wish to remind model-builders that, although any number of parts may be used in building models, it is not necessarily the largest and most complicated models that win the prizes. Very often, indeed, the reverse is the case, and a simple model that is well-proportioned, and displays sound constructional features, secures a prize in preference to a large and elaborate model that is badly designed and constructed.

A typical example of the kind of models that win prizes in "*M.M.*" Competitions is the gas cooker illustrated on this page. This is quite an easily built reproduction of a familiar and homely object, yet the model was successful in winning a good prize in a recent competition, although many of the unsuccessful models entered in the same Contest were much more elaborate and were built from large Outfits.



A familiar object realistically reproduced in Meccano, by Alan Le Claire, Worksop. This gas cooker is an example of the type of models that win prizes in Meccano Model-Building Competitions.

Far more important than a big Outfit in the construction of competition models is originality in choice of subject, and intending competitors in this Contest will be well advised to choose their subjects carefully and to spend some time in searching for novel ideas. Models that are likely to prove most interesting to Meccano enthusiasts throughout the world will stand the best chances of success.

The entries will be divided into three separate sections, and the age of each competitor will be considered in judging. The sections are as follows—A, for competitors over 14 years of age living in the British Isles; B, for competitors under 14 living in the British Isles; and C, for competitors of all ages living Overseas.

Competitors should send in clear photographs, or if this is not possible, good drawings of their models, together with brief explanations of any special mechanical or constructional features that may be present. Actual models must not be sent. Photographs or drawings need not be the competitor's own handiwork, but it is absolutely necessary that the model itself should be his own unaided work. Photographs or drawings of unsuccessful models will be returned to the senders, provided that a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs or drawings of prizewinning models become the property of Meccano Ltd., and will not be returned.

More than one model may be submitted for consideration, but all entries must be enclosed in the same envelope. No competitor can win more than one prize, and if two or more models are entered they will be considered jointly.

The following instructions must be followed closely. The competitor's age, name and address must be written on the back of each photograph or drawing sent in, together with the name of the Contest ("Spring" Model-Building Contest) and the letter A, B or C indicating the Section in which the model is entered.

Envelopes should be addressed "Spring" Model-Building Contest, Meccano Ltd., Binns Road, Liverpool 13.

Readers living in the British Isles must forward their entries so that they reach Liverpool not later than 31st July, 1934. In order to give Overseas readers plenty of time in which to build their models we have extended the closing date for Section C to 29th September 1934. All prize-winners will be notified by post as soon after the closing date as possible, and the list of awards, together with illustrations and descriptions of prize-winning models, will be published in due course in the "*M.M.*" Competitors entitled to prizes consisting of Meccano goods will have the opportunity of choosing any items they like from current price lists. Models that already appear in any Meccano publication are not eligible for this contest.

"Spring" Model-Building Competition

The Prizes

In each of the Sections A, B and C, a separate set of prizes will be awarded as follows:

1st Prize, Meccano or Hornby Goods value £3-3s.
2nd Prize, Meccano or Hornby Goods value £2-2s.
3rd Prize, Meccano or Hornby Goods value £1-1s.
Five Prizes of Meccano or Hornby Goods value 10/6.
Five Prizes of Meccano or Hornby Goods value 5/-.
Certificates of Merit will be awarded in each Section.

Boys! Here's the finest part exchange offer ever made

Just think of it, an allowance of 50% on your old Hornby Locomotive! This is the most generous offer ever made to Hornby Train enthusiasts.

The complete list of Part Exchange allowances for Hornby Locomotives is given on this page. Please note that the catalogue price of the new Locomotive you purchase *must not be less than double the Part Exchange allowance made for your old Locomotive.*

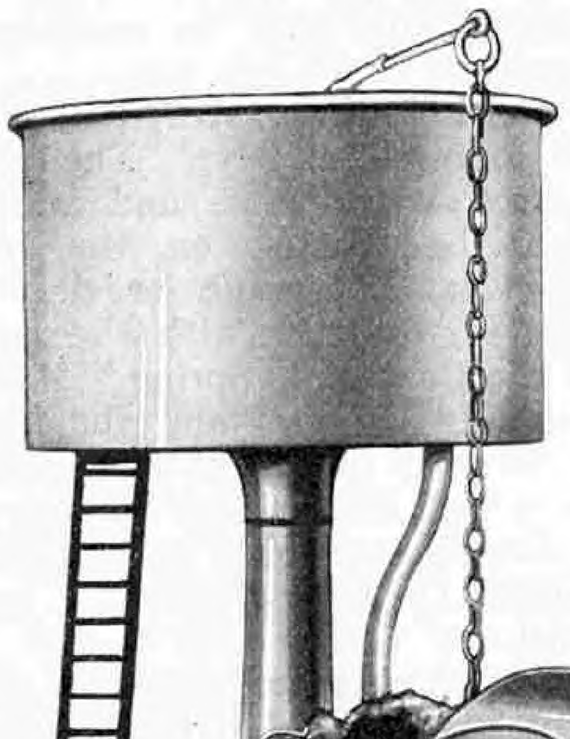
Here is an example of how the plan works. Assuming you have a No. 1 Tank Locomotive that you wish to exchange, you see from the list that its exchange value is 6/3. You then choose a new Locomotive, the cost of which is not less than 12/6.

You decide, say, to have a No. 2 Special Tank, the price of which is 25/–. Pack up your old No. 1 Tank and deduct 6/3 from 25/– (the price of the new No. 2 Special Tank) enclose a remittance for 18/9 plus 1/– carriage on the new Locomotive—19/9 in all. Send the Locomotive and the remittance to Meccano Limited, Binns Road, Liverpool 13.

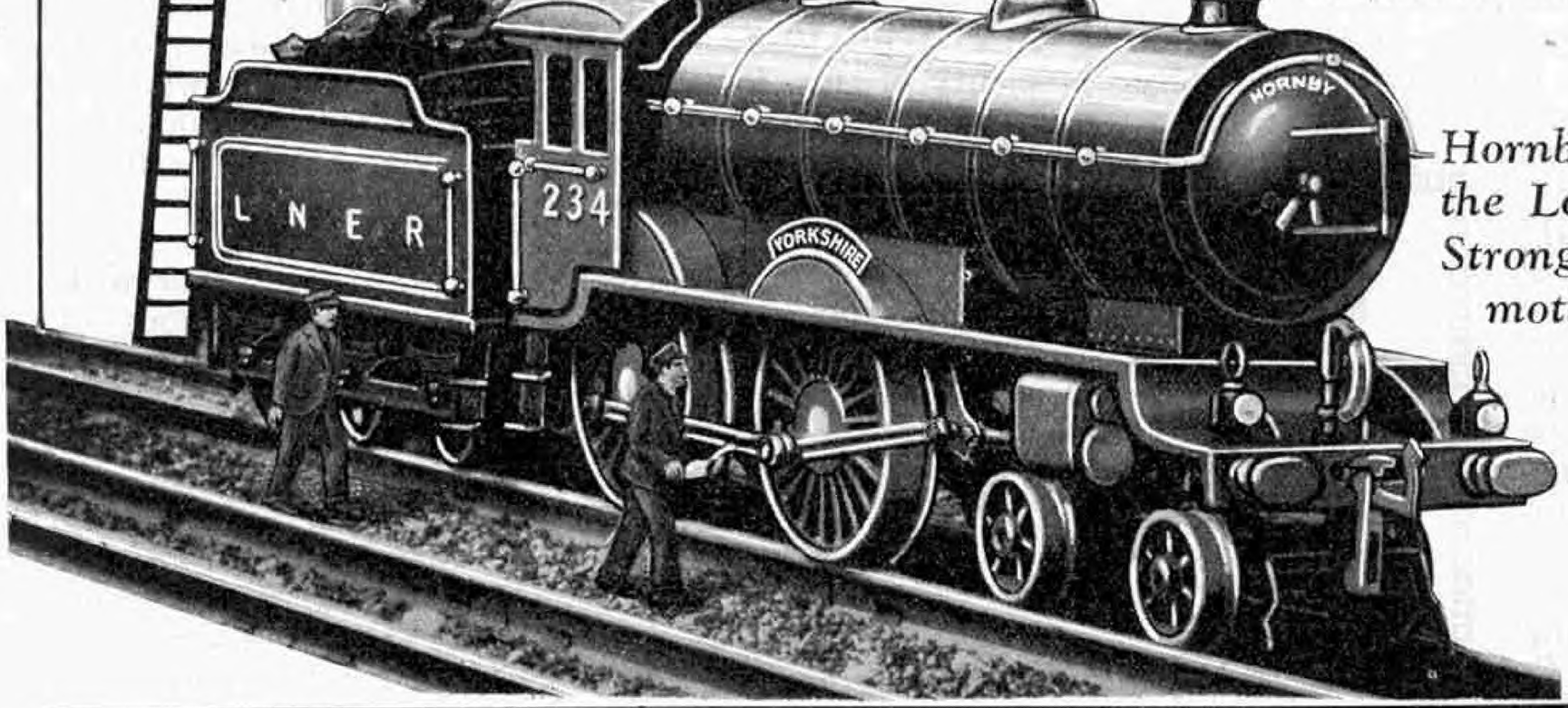
Alternatively, you can take your old No. 1 Tank Locomotive to your dealer with a remittance for 18/9, and he will give you the new No. 2 Special Tank Locomotive that you require.

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NO MATTER WHAT THE AGE OR CONDITION OF YOUR OLD LOCOMOTIVE, YOU CAN EXCHANGE IT UNDER OUR "PART EXCHANGE" PLAN.





Part Exchange Allowances for Hornby Locomotives

CURRENT TYPES

MO Locomotive	1/4
M1/2 Locomotive	2/3
M3 Tank Locomotive	3/9
No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	7/6
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt)	11/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
LST 1/20 Tank Locomotive (20-volt)	12/6
LE 1/20 Locomotive (Swiss Type), 20-volt	13/3
LE 2/20 Locomotive (20-volt)	16/6
No. 2 Electric Tank Locomotive	18/9
No. 3E Locomotive	18/9
No. 3E Riviera "Blue" Locomotive	18/9
No. 3C Locomotive	13/9
No. 3C Riviera "Blue" Locomotive	13/9
Metropolitan C Locomotive	11/3
Metropolitan L.V. Locomotive	20/–

OBSOLETE TYPES

M2930 Locomotive	1/–
George V Locomotive / No. OO Locomotive (These models were identical)	3/3
M3 Locomotive	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6
Metropolitan H.V. Locomotive	20/–

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Forming a Swimming Section

Last summer several Meccano clubs included swimming among their outdoor activities. This innovation was very popular, and the enthusiasm of members led to the formation of strong swimming sections. The Middlesbrough M.C. were pioneers of the sport among Meccano clubs. During the 1933 season nine members of the club learned to swim, and a swimming team was formed that won many matches against local clubs.

Swimming is a splendid exercise, perhaps the best in the world. It has unequalled fascinations of its own, and a race in the water always arouses more excitement than a similar race on land. The activities of a section formed for its encouragement, therefore, cannot fail to appeal strongly to the typical Meccano club member, and I hope that as many Meccano clubs as possible will include the sport in their programmes for the summer. There should be no difficulty in forming sections for this purpose, for swimmers are to be found in practically every club, and their advice and example will encourage beginners to persevere.

The Spirit of the Guild

Every year Meccano clubs establish themselves more firmly as the means by which boys and young men give expression to their creative powers as model-builders, and develop their interest in engineering and scientific hobbies of all kinds. The spirit that animates a Meccano club has led to the realisation that membership does far more than this, and that it helps to develop the best that is in a boy. This is clearly shown in a reference to the Malvern M.C. published in a South African journal of wide circulation. The writer observes that much more lies behind the club than its name suggests, and adds that during its 14 years existence "it has endeavoured to foster friendship and manliness among the juniors; it has done its best to give its youthful members the opportunity to make good; it has encouraged the team spirit, and as a club has always been willing to help in the cause of charity." I hope that the activities of every club will earn similar commendation.

Guild Activities in Canada

The spread of the club movement is well illustrated by recent developments in Canada. A few pioneers showed the way, and to-day there is in that country a chain of these organisations 2,000 miles in length from Montreal in the east to Vancouver and Victoria on the Pacific Coast. These have aroused the interest of capable Leaders, some of whom are closely associated with engineering and science, while all are interested in the activities of boys as well as in the development of the aims and objects of the Guild. In all cases keenness and enthusiasm inspire the members, who show their appreciation of the opportunities offered to them by taking great pride in their clubs and promoting their interests.

Meccano Club Leaders

No. 72. Mr. W. J. Ellis



Mr. W. J. Ellis is Leader of the Plymouth Meccano Club. This club was affiliated in October 1926, and under the wise direction of Mr. Ellis its record has been one of continual progress. The excellent programme followed, and the splendid displays at the well-organised Exhibitions held annually, have earned the club a very high reputation, which members are keen to maintain.

A Typical Meccano Club

The Plymouth M.C. was affiliated with the Meccano Guild as long ago as 1926, and since that time its progress has been rapid and continuous. It is a typical all-round Meccano club, its activities covering every phase of the movement from model-building—naturally the central feature of every club's programme—to competitions, lectures and demonstrations, visits to places of engineering and railway interest, exhibitions, and the social events and excursions that play such a great part in developing friendliness and team spirit among members. The secret of its success is to be found in the thoroughness that officials and members have always displayed.

The Plymouth club has been particularly fortunate in its associations, and it owes the use of its excellent club room to the kindness of the Vicar of Christ Church, Plymouth. Mr. H. Shapcote, M.A., President, and Mr. W. J. Ellis, Leader, spare no effort to make membership profitable in the best possible way. Both attend every meeting, and the cordial and friendly relations they have established with individual members have helped to develop the excellent spirit that characterises the club. The actual management of affairs is left to the members themselves, who elect representatives to the committee. Their slogan is "Happy Hours before Self-Gain," and their efforts, under the inspiration of their leaders, to put this into practice, have made the club one of the finest organisations for boys in the district.

"*The Gear Box*," the club's magazine, appears quarterly, and is well laid out and carefully reproduced. It deals adequately with the domestic affairs of the club and includes also interesting articles on local engineering and railway topics, in addition to general contributions of interest to members. Particularly good use is made of it in connection with the club's Annual Exhibition, for the issue immediately preceding this always contains special pages, printed on coloured paper, on which the chief features of the Exhibition are explained. The issue therefore serves as a guide to the display, and also helps parents of members and other friends of the club to realise the strength of the organisation that lies behind the club itself.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places and boys interested in becoming members should communicate with the promoters, whose names and addresses are given below:

DUNDEE—A. Keddie, 234, Blackness Road, Dundee.
INDIA—P. Chand, Dennys High School, X.A., Rawalpindi, India.
LONDON—R. Hellis, 22, Adelaide Road, Brockley, S.E.4.
LONDON—K. R. Dutton, 7, Wellington Road, Peckham, S.E.15.
SOUTH AFRICA—L. Alley, 461, Burger Street, Maritzburg, South Africa.
SYRIA—George Krajian, P.O. Box 434, Aleppo.



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Boys, Meccano Aeroplane Outfits are great! They enable you to build wonderful models of aeroplanes—the most realistic you ever saw.

The parts contained in these Outfits enable aeroplane construction to be carried out on sound engineering lines because they are all interchangeable on the famous Meccano principle. The illustrated Manual of Instructions included in each Outfit shows how to build high and low wing Monoplanes, Biplanes, Seaplanes and many other interesting models. Buy a Meccano Aeroplane Outfit to-day!

Price List

Standard Series

No. O AEROPLANE OUTFIT

An interesting range of models can be built with this Outfit, including high and low wing monoplanes, seaplanes and standard light biplanes. All the parts are interchangeable. Price 5/-

No. OIP AEROPLANE HANGAR OUTFIT

This novel and attractive Outfit consists of the complete range of No. O Aeroplane Outfit parts packed in a No. O1 Aeroplane Hangar instead of in a carton. Price 10/-

Note. The parts in the No. O and No. O1P Aeroplane Outfits are smaller than those in the other Outfits in the series and are not intended for use with these Outfits.

No. 1 AEROPLANE OUTFIT

Magnificent models of high and low wing monoplanes, and interesting model biplanes representing standard types can be built with this fine Outfit. Price 9/-

Meccano Aeroplane Constructor Accessory Outfit No. 1a, costing 8/6, will convert a No. 1 Outfit into a No. 2.

No. 2 AEROPLANE OUTFIT

This Outfit enables a much wider range of models to be built, including triple-engined monoplanes and biplanes, and a racing seaplane of the type that was used in the Schneider Trophy Contests. Price 16/6

Special Series

No. 1 SPECIAL AEROPLANE OUTFIT

The parts in this Super Aeroplane Outfit will build over 20 realistic models of different types of aircraft. The range of special parts includes main planes fitted with ailerons, tail planes with elevators, movable rudder, radial engine cowling, etc. Price 15/-

A No. 1a Special Aeroplane Accessory Outfit, Price 11/6, will convert a No. 1 Special Outfit into a No. 2 Special.

No. 2 SPECIAL AEROPLANE OUTFIT

This is the finest and most attractive Aeroplane Constructor Outfit on the market. It contains a big range of aircraft parts, with which numerous models of practically any type of machine may be built—44 examples are shown in the Manual of Instructions. All the parts that are special features of the No. 1 Special Outfit are included, also a number of other parts of special design. Price 25/-

All Meccano Aeroplane Outfits are available in three different colour combinations.

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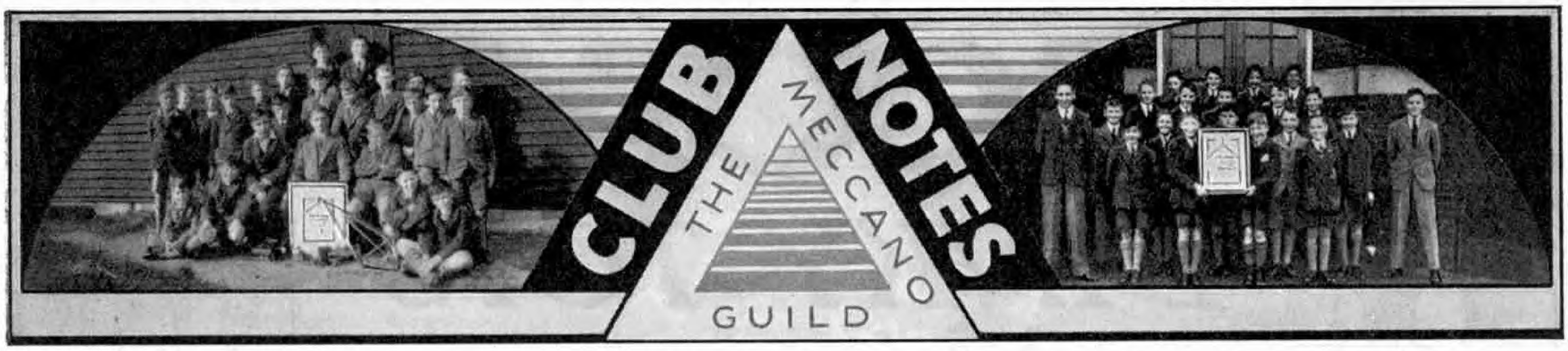
No. O Aeroplane Constructor Outfit



No. 1 Special Aeroplane Outfit



No. 2 Special Aeroplane Outfit



Stone (Glos.) M.C.—This newly affiliated club is making good progress. Meccano models built by members are demonstrated at meetings, one night recently being devoted to trials of model tractors. An Orchestra has been formed and interesting Lectures are given by members. The programme for the summer session includes cycling, cricket and tennis. Club roll: 7. G. Harding, Church House, Stone, Falfield, Glos.

Consett Y.M.C.A. M.C.—Members are very keen and a remarkable proportion of them have been with the club since its formation four years ago. Additions are being made regularly to the stock of Meccano parts available for constructing large models, and a splendid reproduction of the Tyne Bridge has been built. Other events have included interesting Lectures. Club roll: 27. *Leader:* Mr. R. B. Borthwick, 4, Stratford Gardens, Consett.

Wallington County School M.C.—Groups of members are building large original models, including an Overhead Telpher Span, a Cliff Railway, a Submarine and a Tramcar. Special interest is being taken in a model of the "F.P.1" Floating Platform for aeroplanes, and in a Steam Roller fitted with a Meccano Steam Engine that has been given many successful trial runs. Other events have included a Social, each member contributing refreshments, and a Model-building Contest in which competitors had to construct any model they pleased in 45 mins. A Crane constructed by a new member was judged the best in this Contest, and an interesting discussion on the entries followed the announcement of the award. Club roll: 10. *Secretary:* K. H. Baker, "Glenview," 50, Wordsworth Road, Wallington, Surrey.

St. John's School (Bridgwater) M.C.—Members of both Junior and Senior Sections have been busy with models for the club's Exhibition. Members of the Junior Section constructed a Model Fairground, and a Dockyard display was organised by the Senior Section. Prizes were awarded for the best models on view. Talks have been given by Mr. C. J. H. Sanderson, Leader of the club, on ancient and modern steam engines, and on pumps and other hydraulic appliances. A Morse Code Section has been formed, half an hour each week being devoted to practice. Club roll: 15. *Secretary:* L. R. Temple, 46, Monmouth Street, Bridgwater, Som.

St. Columba's (Sunderland) M.C.—Model-building has been continued with unabated enthusiasm, recent subjects including Mining Machinery, Ships and Shipyard appliances, in addition to Motor Cars and Aeroplanes. A Conjuring Exhibition was given by three members and Tournaments for Table Tennis and other games have been organised. Special interest was taken in an Air Rifle Shooting Competition. Club roll: 13. *Secretary:* R. Brooks, 72, Edward Burdis Street, Southwick, Sunderland.

Beckenham M.C.—An interesting programme is being followed and the interest of all members is being stimulated by the variety of attractions, which include Lantern Lectures, Electrical Demonstrations and a Stunt Night in addition to Model-building and Hornby Train Evenings. Many promising models, ranging from an elaborate Motor Car to a Dustcart, were submitted in a Contest for models representing anything seen upon the road. Club roll: 15. *Secretary:* B. J. Carvell, 45, Sidney Road, Beckenham, Kent.

Fulstow M.C.—A series of Model-building Contests has been held, entries being judged by Mr. W. L. Phillips, Leader of the club. Indoor Game Tournaments have been arranged and Bagatelle, Table Tennis and other matches played between the sections of the club. Indoor Air Rifle Shooting is one of the chief recreations of members, who greatly enjoy shooting at cardboard representations of animals placed in positions of varying difficulty. Club roll: 11. *Secretary:* S. Doe, The Stores, Fulstow, North Thoresby, S.O.

Kendal M.C.—A particularly interesting meeting followed the visit of a member of Toc H, who described his war experiences, including an incident in which a V.C. was won. The visitor promised a prize for a special Model-building Contest. Members are keenly interested in Competitions of all kinds, and in Debates, a recent discussion being on the relative merits of road and rail transport. Interesting films loaned by industrial firms have been shown with the aid of a projector belonging to one of the members. Club roll: 15. *Secretary:* Mr. L. Haslam, Middleton, Kirkby Lonsdale, Carnforth.

Whitgift School M.C.—All sections of the club are active in Model-building and other practical work. Further interesting visits have been greatly enjoyed, including inspection of the projecting room of a picture house and tours round the factory of the Gramophone Co. Ltd. at Hayes and the G.W.R. Locomotive Sheds at Old Oak Common, where special interest was displayed in an electric turntable and a steam hammer. The club's Annual Exhibition was very successful. Club roll: 57. *Secretary:* H. J. Kirby, "Minniscot," Riddlesdown Avenue, Purley, Surrey.



Members of the Correspondence School, Wellington, M.C., with Mr. C. M. Haybittle, secretary of the School "Meccano Magazine" circle, on the right in the second row. Members are widely scattered throughout New Zealand and cannot meet in the usual manner, but show great keenness in the special Model-building Contests organised for them.

Sid Vale M.C.—A novel touch was given to a recent Model-building Contest by the selection of the Loch Ness Monster as the subject, and many fearsome creatures were submitted to the judges. Other Contests have dealt with racing cars and similar subjects, and special attention has been given to "Simplicity" models. Club roll: 25. *Secretary:* R. Gliddon, Sheffield House, Sidmouth.

Plymouth M.C.—Great activity in Model-building is displayed by members, who construct models at home for display at club meetings, when marks are awarded. Recent subjects for Competitions of this kind have included Fairground models, Cranes and Steam Engines. Marking is very strict, but G. Symons distinguished himself by scoring full marks in successive contests. The issues of "*The Gearbox*" continue to be of high quality, the sections dealing with local railways, tramcars and omnibuses being noteworthy. Club roll: 70. *Secretary:* P. C. Frizzell, 85, Beacon Park Road, Swilly, Plymouth.

Dagenham M.C.—The resignation of the Leader has led to the reorganisation of the club, which is under the temporary Leadership of S. Pashley, formerly the general secretary. Excellent models are being produced by the "Nuts" and "Bolts," each section carrying on work under its own Leader, who retains office for a month in order to give experience of official posts to as many members as possible. The club recently celebrated its second birthday by an enjoyable Social. A magazine to be called "*The Spanner*" is to be produced and excellent outings have been arranged for the outdoor season. Club roll: 20. *Secretary:* S. Pashley, 84, Holgate Road, Dagenham.

Glendale College (Westcliff-on-Sea) M.C.—Keen interest was displayed in the preparations for the club's successful Exhibition. The chief attraction was a Colliery Scene, the coal produced being despatched on trains running on an extensive Hornby Train layout. A Wagon Tipping Plant and other appropriate models were correctly placed on the layout and were in operation throughout. Members also exhibited individual models, the Exhibition replacing the usual monthly Model-building Contest. There was keen competition in a special Model-building Contest in which only the parts included in a No. O Meccano Outfit could be used. Members are to present plays on Speech Day. Club roll: 40. *Secretary:* D. Lake, "Churston," 17, Meadway, Westcliff-on-Sea.

AUSTRALIA

Melbourne M.C.—A second "Meccano Games Night" has been held. The models included a Box Ball Alley and the Aerial Bombing Game described in the "*M.M.*" for October, 1932, and the proceedings were as enjoyable as on the previous occasion of this kind. Model-building is being vigorously pursued, and good use is made of the super model, the Gantry Crane, in operation on the track of the associated Branch of the H.R.C. A joint visit was made to the "*Otranto*" by members of the Marlborough (Mont Albert) and Melbourne clubs, who afterwards inspected two Australian warships. The electric railway of Mr. L. Ison, Leader of the club, was operated by members at two special meetings. One of these was the last for 1933 and concluded with refreshments and games. Club roll: 15. *Secretary:* L. Ison, 8, Hayes Street, Northcote, N.16, Victoria, Australia.

INDIA

Kognolkar M.C.—An interesting trip to Khajraho was greatly enjoyed by all the members. Excellent general meetings for model-building and other purposes have been held, and at one of these an address was given to members by Mr. R. N. Bhate. Club roll: 9. *Secretary:* R. M. Kognolkar, Nowgong, C.I. India.

SOUTH AFRICA

Western Province Preparatory School M.C.—A very successful Exhibition was held, members building many remarkable models of original design. Models built by members of other Meccano clubs added to the attractions of the display. Excellent use was made of side shows and the receipts amounted to more than £3. The Exhibition aroused great interest and a long report of the proceedings appeared in the Capetown press. Members paid an enjoyable visit to a Social organised by members of the Observatory M.C. Club roll: 53. *Secretary:* B. B. Strickland, "Merton," Paradise Road, Newlands, Cape, South Africa.

MECCANO

DINKY TOYS







Meccano Dinky Toys No. 1
STATION STAFF

No. 1a	Station Master	each 3d.
No. 1b	Guard	,, 3d.
No. 1c	Ticket Collector	,, 3d.
No. 1d	Driver	,, 3d.
No. 1e	Porter with bags	,, 3d.
No. 1f	Porter	,, 3d.

Price of complete set 1/6



Meccano Dinky Toys No. 4
ENGINEERING STAFF

No. 4a	Electrician ...	each 3d.
No. 4b	Fitters	,, 3d.
No. 4c	Storekeeper ...	,, 3d.
No. 4d	Greaser	,, 3d
No. 4e	Engine Room Attendant	,, 3d

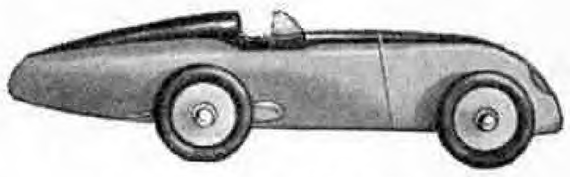
Price of complete set 1/6



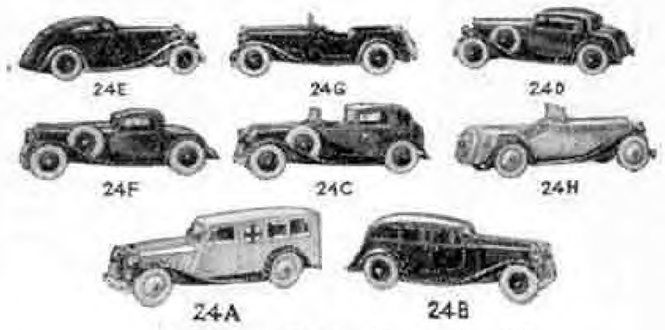
Meccano Dinky Toys No. 3
PASSENGERS

No. 3a	Woman and Child	each 3d
No. 3b	Business Man	,, 3d.
No. 3c	Male Hiker	,, 3d.
No. 3d	Female Hiker	,, 3d.
No. 3e	Newsboy	,, 3d.
No. 3f	Woman	,, 3d.

Price of complete set 1/6



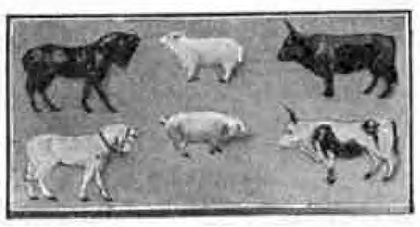
Meccano Dinky Toys No. 23
RACING CAR
Assorted Colours. Fitted with rubber tyres.
Price 6d. each



Meccano Dinky Toys No. 24
MOTOR CARS
Fitted with rubber tyres and silver plated radiators.

No. 24a	Ambulance	each 9d.
No. 24b	Limousine	,, 9d.
No. 24c	Town Sedan	,, 1/-
No. 24d	Vogue Saloon	,, 9d.
No. 24e	Super Streamline Saloon ...	,, 9d.
No. 24f	Sportsman's Coupé (2 seater)	,, 9d.
No. 24g	Sports Tourer (4 seater) ...	,, 1/-
No. 24h	Sports Tourer (2 seater) ...	,, 1/-

Price of complete set 6/6



Meccano Dinky Toys No. 2
FARMYARD ANIMALS

No 2a	Horse each 3½d.	No. 2c Pig	each 2d.
No. 2b	Cow ,, 3½d.	No. 2d Sheep	,, 2d.

Price of complete set 1/6

Meccano Dinky Toys No. 28/1
DELIVERY VANS

Manchester Guardian Van	each 9d.
Palethorpe's Sausage Van	,, 9d.
Hornby Train Van	,, 9d.
Pickford's Removals Van	,, 9d.
Oxo Van	,, 9d.
Ensign Cameras' Van	,, 9d.

Price of complete set 4/6

Boys, Meccano Dinky Toys are the most realistic and the most attractive models in miniature ever produced. They are made of the best material obtainable, and are all finished in beautiful colours.

Many of these toys are ideal for giving the finishing touch to your model railways. You must have railwaymen to deal with your trains, and passengers to travel in them: car attendants to look after the passengers, and engineers for the maintenance of the railway and its equipment. You want farmyard animals for lineside fields, and you should have at least one of the famous "Hall's Distemper" advertisements alongside your line!

Then there are the miniature train sets, rail autocar and various other types of motor vehicle. You can have hours of fun running these on the table or on the floor, arranging road and rail transport services from one point to another.

These splendid toys may all be purchased separately at the prices shown, or they may be obtained in complete sets. Ask your dealer to show you the complete range of Meccano Dinky Toys.



Meccano Dinky Toys No. 19
MIXED GOODS TRAIN SET

No. 21a	Tank Locomotive	each 9d.
No. 21b	Wagon	,, 4d.
No. 21d	Petrol Tank Wagon	,, 6d.
No. 21e	Lumber Wagon	,, 5d.

Price of complete set 1/11



Meccano Dinky Toys No. 20
PASSENGER TRAIN SET

No. 21a	Tank Locomotive	each 9d.
No. 20a	Coaches	,, 7d.
No. 20b	Guard's Van	,, 7d.

Price of complete set 2/6



Meccano Dinky Toys No. 18
GOODS TRAIN SET

No. 21a	Tank Locomotive	each 9d.
No. 21b	Wagons	,, 4d.

Price of complete set 1/9



Meccano Dinky Toys No. 22
MOTOR VEHICLES

No. 22a	Sports Car each 6d.	No. 22d	Delivery Van each 8d
No. 22b	Sports Coupé ,, 6d.	No. 22e	Tractor ... ,, 9d.
No. 22c	Motor Truck ,, 8d.	No. 22f	Tank ... ,, 1/-

Price of complete set 4/-



Meccano Dinky Toys No. 5
TRAIN AND HOTEL STAFF

No. 5a	Pullman Car Conductor ...	each 3d.
No. 5b	Pullman Car Waiters... ...	,, 3d.
No. 5c	Hotel Porters	,, 3d.

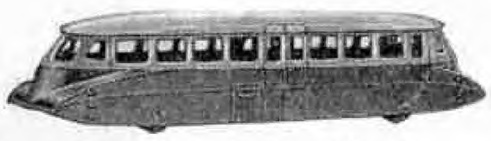
Price of complete set 1/3



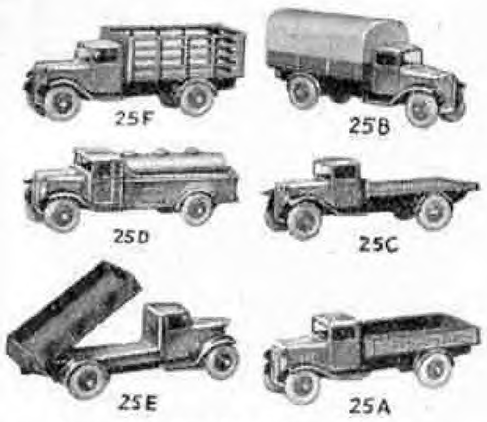
Meccano Dinky Toys No 6
SHEPHERD SET

No. 6a	Shepherd	each 3d.
No. 6b	Dog	,, 3d.
No. 2d	Sheep	,, 2d.

Price of complete set 1/2



Meccano Dinky Toys No. 26
RAIL AUTOCAR
Assorted Colours ... ... Price 6d. each



Meccano Dinky Toys No. 25
COMMERCIAL MOTOR VEHICLES
Fitted with rubber tyres and silver plated radiators.

No. 25a	Wagon	each 9d.
No. 25b	Covered Van	,, 9d.
No. 25c	Flat Truck	,, 9d.
No. 25d	Petrol Tank Wagon	,, 9d.
No. 25e	Tipping Wagon	,, 9d.
No. 25f	Market Gardener's Van ...	,, 9d.

Price of complete set 4/6

Meccano Dinky Toys No. 13
HALL'S DISTEMPER ADVERTISEMENT
This miniature of a well-known line-side advertisement is intended to be placed in the fields adjoining the railway track. Price 9d.

Meccano Dinky Toys No. 28/2
DELIVERY VANS

Kodak Cameras' Van	each 9d.
Sharp's Van	,, 9d.
Crawford's Biscuit Van	,, 9d.
Wakefield's Oil Van	,, 9d.
Marsh and Baxter's Van	,, 9d.
Meccano Van	,, 9d.

Price of complete set 4/6

MANUFACTURED BY MECCANO LTD., LIVERPOOL 13



Branch News

NOTTINGHAM SHIGHCHOOL—The Branch now meets in the Junior Physics Laboratory and Workshop of the school, and the new rooms provide more facilities for good work and better storage accommodation. A Meccano Section has been formed, and is carrying on interesting model-building work in order to supplement Hornby Train activities. Interesting visits arranged have included a tour of the Whipsnade Zoological Park and an inspection of a local dye works. Secretary: F. R. N. Nabarro, 4, Grosvenor Avenue, Mapperley Park, Nottingham.

SEFTON—A new Branch room has been secured and members have been busily engaged in planning and laying down a new track. A bell signalling system has been installed, and the layout is now adequately lighted. Time-tables have been worked out and the interesting track nights now possible are being greatly enjoyed. The Library includes more than 70 books and is very popular with members. Secretary: D. Michell, Wynscombe, Albany Avenue, Prescot.

WEST LEIGH (LEIGH-ON-SEA)—Junior and senior members have held track meetings on a layout that has been developed after trials of several types. Members of both sections are now expert in operations, and extra trains are introduced without disturbing the timetable of ordinary services. A special Lantern Lecture telling the story of Peter Pan was arranged for the Junior Section, and an attractive feature of a cinematograph entertainment was a film showing the flight of the "*Graf Zeppelin*" from Germany to South America. A Social was held to celebrate the grant of incorporation. Secretary: K. G. Cross, 129, Southsea Avenue, Leigh-on-Sea.

COTTESMORE.—This newly incorporated Branch is attached to the Cottesmore Central School. Three meetings are held each week. One is devoted to track operations, and intensive services are run on a track 250 ft. in length, 10 locomotives finding employment in this work. At other meetings layouts designed by members are discussed and tried, and Lectures on railway subjects are given by members of the school staff who are interested in the Branch. The Lectures are illustrated by means of lantern slides and epidiascope projections. Secretary: J. S. Butler, Cottesmore Central School, Lenton, Nottingham.

CRAIGIE (PERTH)—The Branch track is continually being extended and operations made more realistic by the introduction of accessories. An interesting feature of the track is a bank on which the services of a banking engine are required. Members show great ingenuity in planning devices for inclusion in the layout and one useful addition of this kind is a Hydraulic Coal Lift. Secretary: S. J. Hardman, 16, Priory Place, Craigie, Perth.



Members of the West Leigh Branch, No. 241, with Mr. F. C. Cross, Chairman, in the centre of the group and K. G. Cross, secretary, on his right. This Branch was incorporated in February 1933. Track meetings of a particularly interesting type are the chief features of the programme, and these are varied by means of Lantern Lectures on railway topics. Photograph reproduced by courtesy of F. A. Johnson and Son.

HILLPLACE (CRAWLEY)—Members are showing great keenness and the attendance record is excellent. At present experimental tracks are being laid down at each meeting. One of the most successful of these was a double line track, with a terminus at each end, into which a simple electric signalling system was introduced. A Library has been formed. Secretary: B. Delany, Purple Ridge, Coleman's Hatch, Sussex.

KILMAURS—The Branch Display was opened by Rev. A. MacGregor, Chairman of the Branch. The results of members' hard work in making preparations were seen in smooth running on the Branch track that greatly attracted the many visitors, who showed their appreciation by contributing to a collection that realised more than £2. After deducting expenses, the proceeds of the Display will be added to the fund set apart for electrification of the Branch track. Secretary: J. Marshall, 52, Main Street, Kilmaurs, Kilmarnock.

PEVERIL (MANCHESTER)—A permanent layout has been designed and experiments have enabled this to be signalled in a satisfactory manner, with the result that intensive services can now be run safely. The track represents the L.N.E.R. main line from King's Cross to Waverley (Edinburgh), and colour-light signals are being installed. Profitable visits have been paid to the Annual Exhibition of the Manchester Model Railway Club and to Gorton Running Sheds. A Cycling Club has been started as part of the activities of the outdoor season. Secretary: R. A. Owens, 18, Amherst Road, Fallowfield, Manchester, 14.

PRIORY (HIGH WYCOMBE)—After discussions and experiments, an extensive double track that can readily be operated by members has been designed and very satisfactory running is now being carried out. Each member deals with a section of the track, controlling shunting and other operations in his own area. Secretary: J. T. Cosgrove, 54, Priory Road, High Wycombe, Bucks.

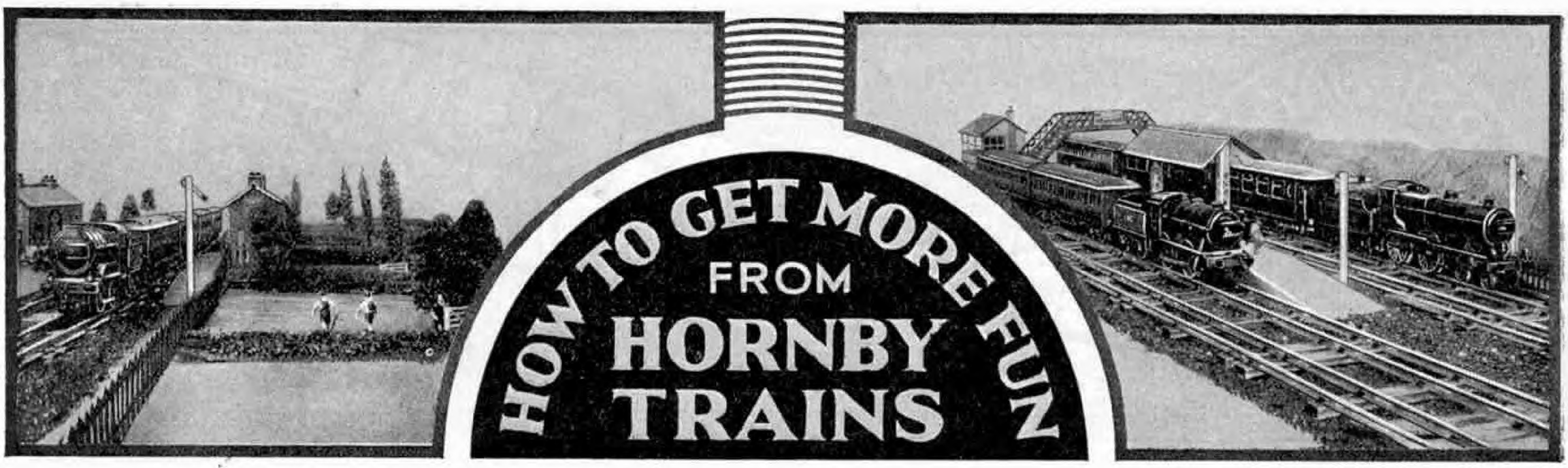
ELMSIDE (EXETER).—At track meetings train services of various kinds have been run with great success and shunting operations have been carried out in connection with goods working. Interesting Mock Trials have been held, members being prosecuted for breaches of club discipline, burglary and other offences, culprits being heavily punished when found guilty. A Cycling Section has now been formed. Secretary: D. Legg, 25, Chute Street, Exeter.

FRANCE

MULHOUSE (ALSACE)—Members are greatly encouraged by the success of their application for incorporation. Regular operations are carried out on an extensive layout, which is now being electrified and provided with signal cabins. Experiments are being made with automatic signalling methods in order to decide which is best for use on the Branch track. A telegraph system is being constructed and incorporated with the layout. Secretary: A. Bernard, 39, Rue Daguerre, Mulhouse (Haut-Rhin) France.

Branches Recently Incorporated

261. BRANKSOME SCHOOL—C. Morris, Branksome, Godalming, Surrey.
262. MULHOUSE (FRANCE)—Andre Bernard, 39, Rue Daguerre, Mulhouse.
263. COTTESMORE—Mr. J. S. Butler, Cottesmore Central School, Lenton, Nottingham.

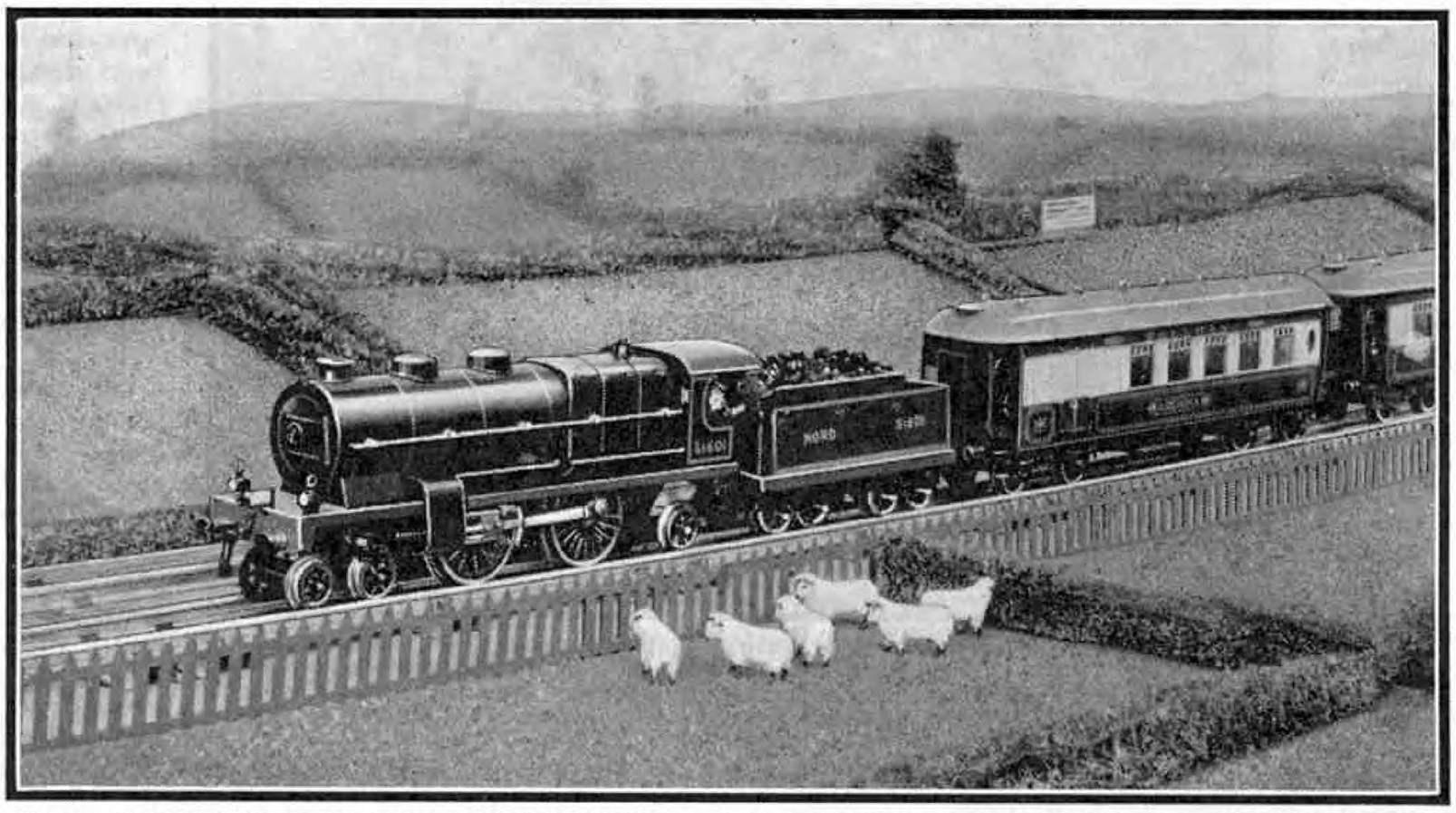


LXVII.—HORNBY LOCOMOTIVE WHEEL ARRANGEMENTS

ONE of the most interesting and important matters connected with the operation of a miniature railway system is the provision of suitable locomotives for the trains to be operated. The actual plan of a system may be dependent also on the types of engine actually available or contemplated, as the larger engines necessitate 2 ft. radius curves and points, and shed and siding accommodation in the layout must be provided on a corresponding scale.

In this selection of miniature locomotives the Hornby railway owner combines with his numerous other official capacities the functions of the Chief Mechanical Engineer of his line, and also those of the Locomotive Running Superintendent. As Chief Mechanical Engineer he provides and maintains suitable types of engine for the traffic of his railway, bearing in mind the "engineering" or other restrictions that may affect his selections. As Locomotive Running Superintendent he has to supervise the actual working of the engines, and see that suitable power is provided for the trains laid down in the general working timetable. He also has to see that the best use is made of the engines, and that excessive mileage running "light" is avoided. As the requirements in the last two respects will vary according to the scheme of operations, and the layout of individual lines, we cannot deal with them in detail here, but no doubt it will interest "*M.M.*" readers if we review the various types available in the Hornby Series, and comment on their respective merits. In this article we shall confine ourselves to the clockwork types. Where corresponding electric engines are available they may be taken as suitable for similar duties, but we will deal with them in detail at a later date.

The biggest engines in the Hornby Series—there is always a special attraction about the biggest examples of anything—are those of the No. 3 variety, which are available for clockwork or electric systems. The wheel arrangement adopted is the 4–4–2 with outside cylinders. The placing of the coupled wheels centrally enables an engine of this type to traverse the standard 2 ft. radius curves and points at speed, in spite of its length and the presence of outside cylinders, for the leading bogie and trailing pony truck provide the necessary flexibility in the wheelbase.



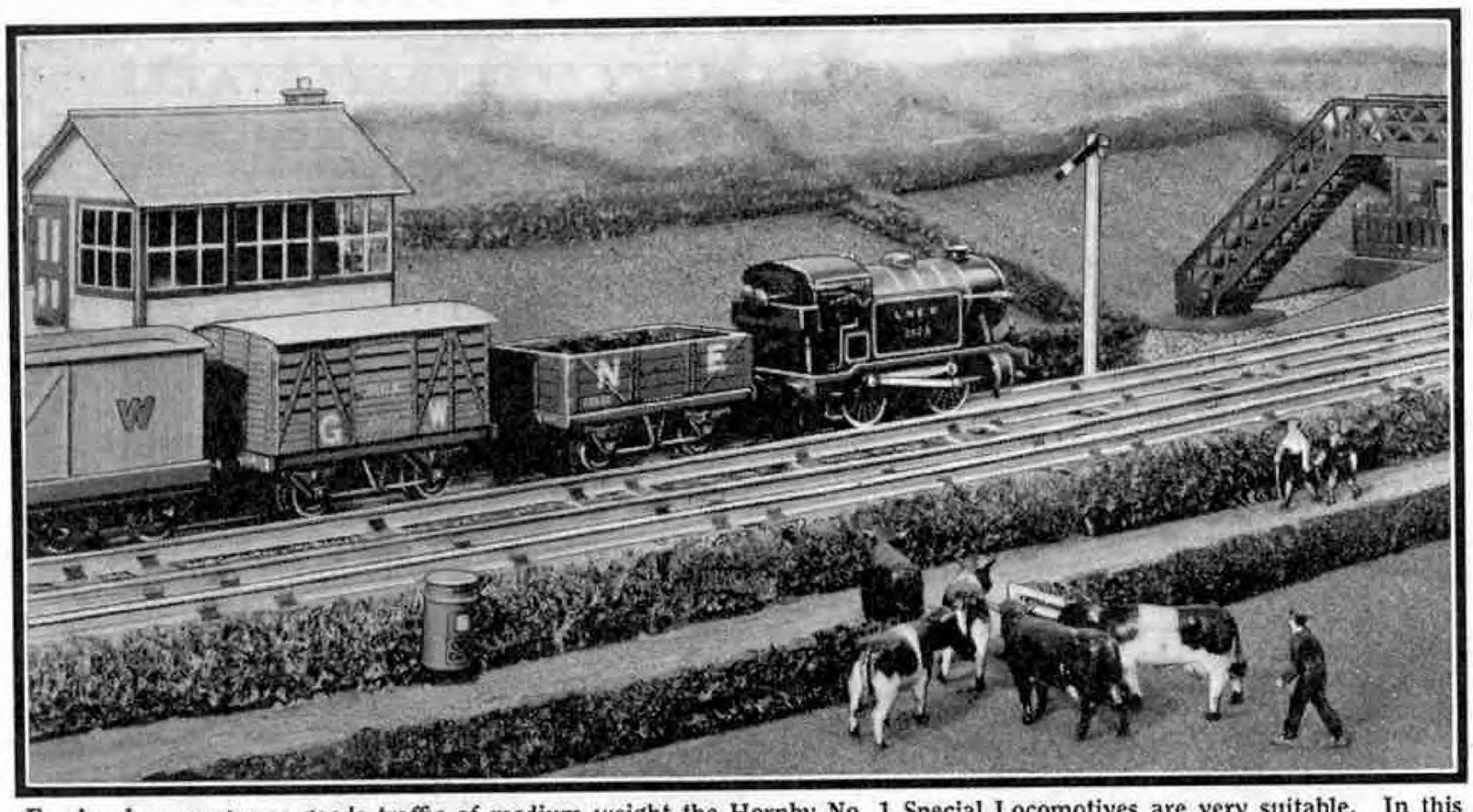
The popular Nord Riviera Locomotive of the Hornby Series. This is a good example of the 4-4-2 type, which gives a flexible wheelbase that is useful for negotiating the curves and points of a miniature layout.

A good example of this type, and a very popular one, is the Hornby Riviera "Blue" Locomotive. This is typical of French locomotive practice, with its stove-pipe chimney, sand-dome on the boiler, and flat-topped fire-box, and it represents very well the famous De Glehn compounds of the Nord System. Its general appearance is well shown in the photograph on this page, from which it will be seen that its tender is of the large bogie type that is favoured abroad. The British groups are also represented by No. 3 Locomotives, the *"Royal Scot," "Flying Scotsman," "Caerphilly Castle,"* and *"Lord Nelson"* being the prototypes selected. Although they are of the same general design, there are differences between the individual engines according to the practice of the companies that they represent. A different true-to-type tender is available for each locomotive.

The well-known endurance speed and power of these engines make them suitable and imposing locomotives for express trains. They may also be used quite well for fast goods work. Many express locomotives put in part of their time on these duties nowadays, the general policy being to obtain as much mileage as possible

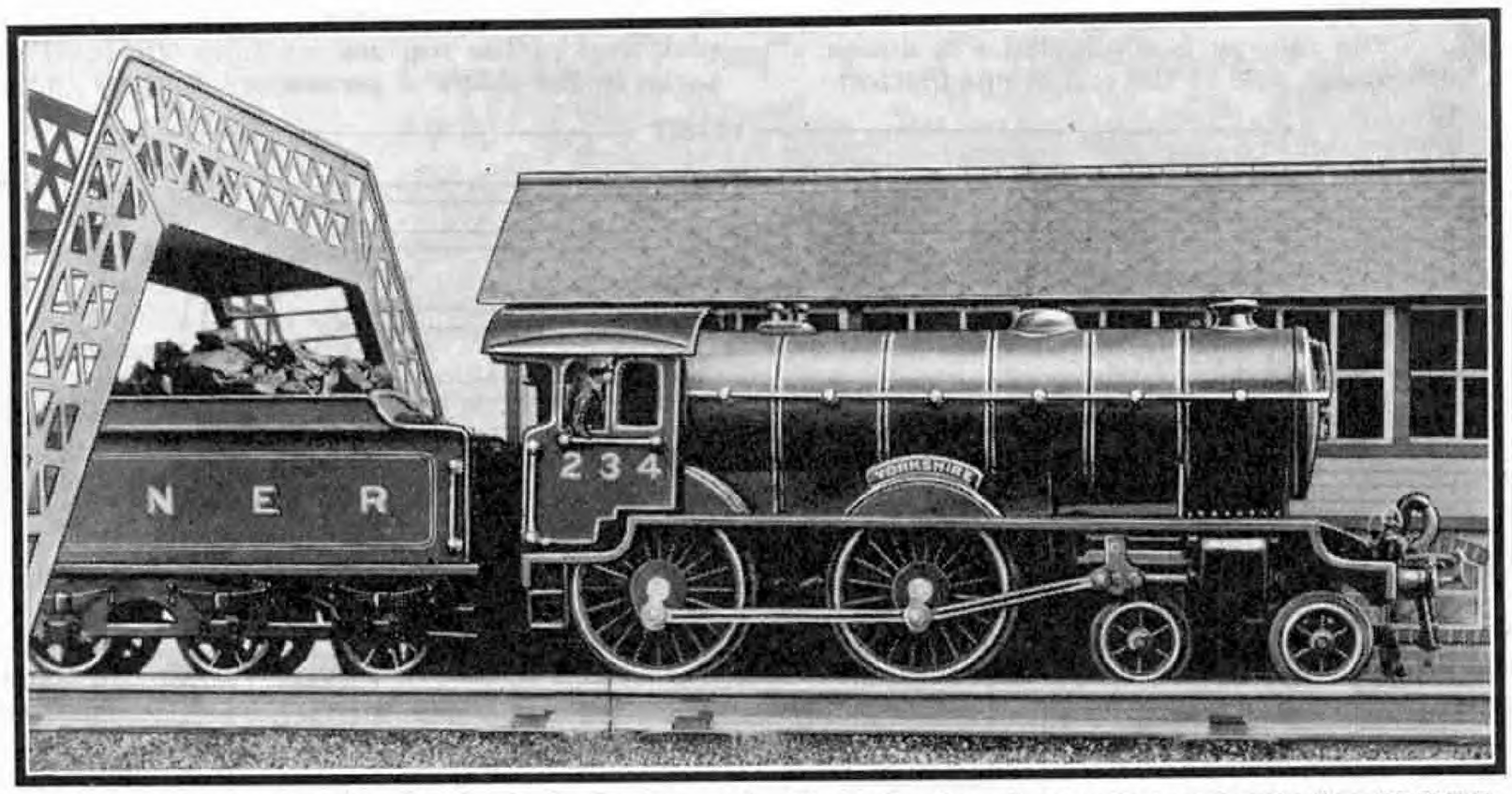
from fewer engines than was formerly the case.

We now come to the popular 4–4–0 wheel type, of which there are four separate representatives in the Hornby Series. These are particularly interesting in that each one is a true-to-type representation of the actual locomotive, so that they exhibit the characteristics standard in the locomotive practice of the British railway groups. The engines thus modelled are the Standard Compounds of the L.M.S.R., the "Shires" of the L.N.E.R., the "Counties" of the G.W.R., and the "L1" class of the S.R. A miniature "Yorkshire" appears in the photograph on this page, and all of them have frequently been illustrated in these pages. Their clockwork mechanisms are of the same type as those fitted to the No. 3 Locomotives. Their capabilities are therefore practically identical with those of the engines previously mentioned, and they are suitable for the same kinds of work.



For local passenger or goods traffic of medium weight the Hornby No. 1 Special Locomotives are very suitable. In this photograph a No. 1 Special Tank Locomotive with a stopping goods train is approaching a station.

Turning now to tank locomotives, the corresponding engine of this type is the No. 2 Special Tank. Although this has the 4–4–2 wheel arrangement, the trailing wheels are under the bunker, and thus such an engine is the tank version of the 4–4–0 tender locomotive, rather than of the 4–4–2 as is sometimes supposed. In certain of its characteristics it resembles the No. 3 Locomotive, particularly in the large boiler and firebox; and with side tanks and a bunker it makes an effective engine for short-distance express work, fast and heavy suburban service, and of course goods traffic. It is available in passenger or goods liveries, so that an example of each may be in service on the same line without any great degree of sameness being noticeable.



A typical miniature locomotive of the 4-4-0 wheel arrangement. The engine shown is a true-to-type reproduction of L.N.E.R. No. 234 "Yorkshire," and is one of the famous Hornby No. 2 Specials.

The particular advantages of tank locomotives were described in the article in these pages last month dealing with the "Tilbury" section of the L.M.S.R., and will therefore be fresh in the minds of readers. The No. 2 Special clockwork mechanism is fitted. It is useful to remember when planning locomotive yards and station layouts that the No. 2 Special Tank can be accommodated on the No. 2 Turntable.

The remaining engines of the Hornby Series are all four-wheelers, whether tender or tank. In some of the smaller engines the driving wheels are not coupled, but we may consider them all as being of the 0–4–0 wheel arrangement. In spite of this, however, there is a surprising variety of them, both tender and tank. We pass now to the No. 1 Special class, the examples of which have several outstanding characteristics. They are essentially of up-to-date design, with outside cylinders and steam pipes, raised footplates and large boilers. They are capable of long runs with good loads, and owing to their general characteristics and handiness they may well be described as "mixed traffic" engines. The tender of the No. 1 Special Tender Locomotive is four-wheeled, but is of imposing yet neat outline, and suits the engine very well.

The tank locomotive of this class has a similar mechanism to that of the tender engine. It is a suitable locomotive for heavy shunting and for local passenger and goods service. Its general appearance is evident from the upper illustration on this page, where it is shown on a local goods train.

All the locomotives so far described can be braked or reversed from the track by means of the special BBRI Brake and Reverse Rail; and all Hornby clockwork locomotives have levers in the cab for hand operation of the brake and, with the exception of the MO, of the reverse gear.

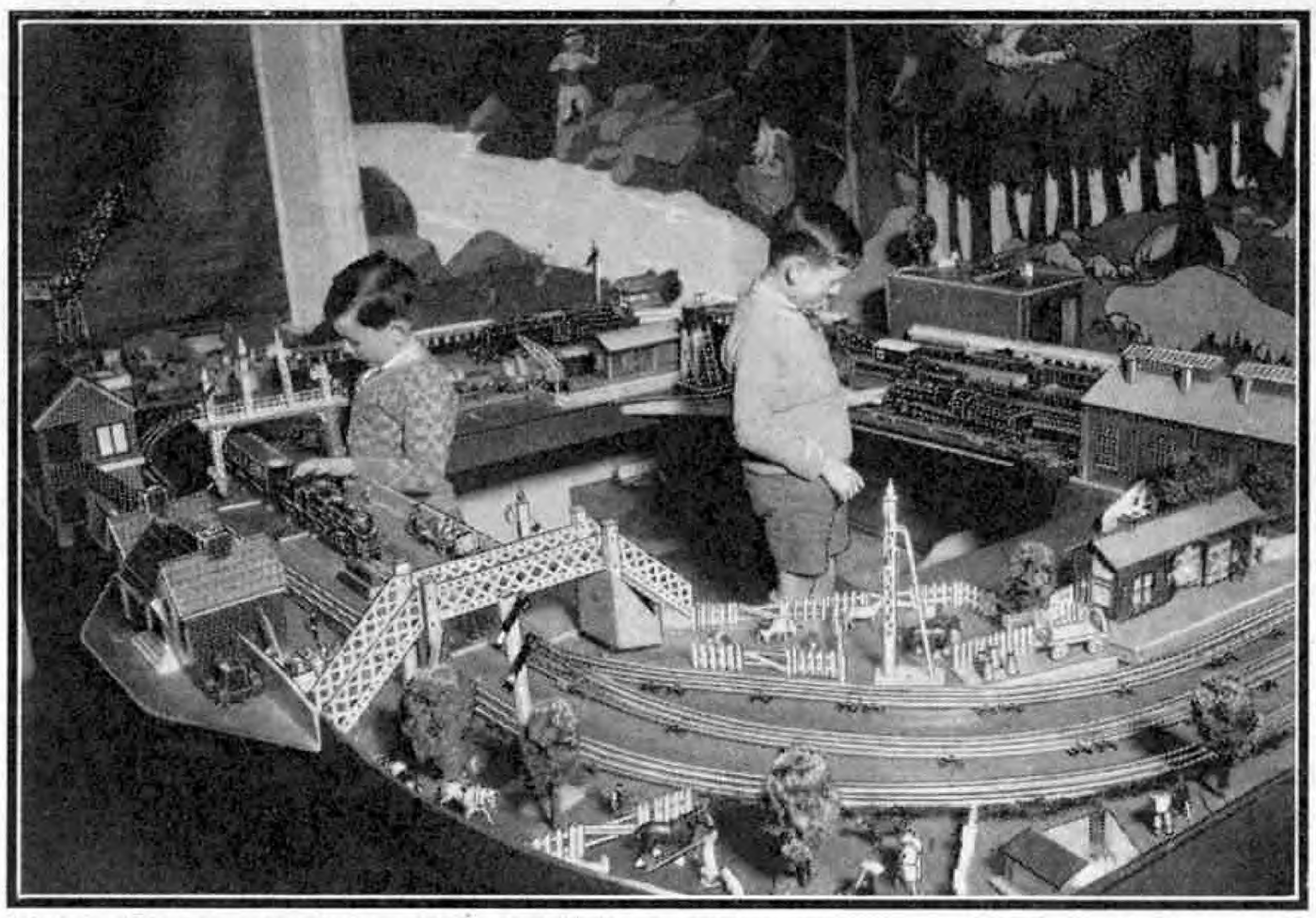
The No. 1 Locomotives resemble the No. 1 Specials in that both tender and tank designs are available. Their general type is similar to that of the No. 1 Special engines, and they are suitable for the same kind of work, although as their mechanisms (*Continued on page 385*)

An Attractive Hornby Railway System

The Layout of D. and E. Birkbeck

ALTHOUGH the question of space with regard to miniature railway layouts is a serious one, it is surprising within what limits an effective system can be arranged. For instance, the layout shown on this page, although it incorporates the large or 2 ft. radius curves, occupies a space of only 10 ft. by 7 ft., which is very satisfactory when the amount of track used is considered. The layout belongs to two keen Hornby railway enthusiasts, Donald and Eric Birkbeck of Newcastle-on-Tyne, and is electrically operated throughout by means of a Meccano Transformer.

The track is laid on a raised foundation, which is of great convenience for operating purposes, as compared with layouts arranged on the floor. There is a clear space in the centre, which enables easy access to be obtained to all parts of the line. The system consists essentially of a double track main line connected by crossover points in two places. These two tracks form the up and down lines respectively on which the chief traffic of the railway is conducted. A double platform station serves both routes, and at the end of one platform there diverges from the inner road a branch line serving a separate station.



A view of the interesting layout of D. and E. Birkbeck, of Newcastle-on-Tyne. This is electrically operated, and is complete with many scenic details.

This branch line follows the general contour of the main lines, and then splits into two by means of parallel points. One of these branches terminates as a dead-end siding, whereas the other, continuing on its way, finally rejoins the inner main line. The loop thus formed therefore provides a through connection, which is found useful when carrying out a programme of train operations. It can be used as a relief line to the main track for through running, or employed merely as a siding.

Close to the trailing connection of the loop with the main line is a further set of points. The track thus thrown off splits by means of parallel points into two sidings, which lie in the opposite direction to the dead-end road previously mentioned. They too, are terminated by buffer stops in a similar manner. There is also a short branch leading from the main line close by the station to the Goods Platform. This Platform is centrally situated, and thus conveniently placed for the actual loading and unloading of goods, which is a feature in the operation of the line.

At right-angles to this track is situated a No. 2 Engine Shed and rails for the accommodation of the locomotive stock. This "yard" is unusual in that it has not as yet any direct connection with the main tracks; and therefore it is only used for the preparation and disposal of the engines, as no running to or from it can be carried out. It is possible that a turntable might be employed to connect the single "loco road" beyond the parallel points with the existing Goods Platform line, the Platform itself being moved slightly. Actually in the course of operations it is found that lack of through connection is not felt very much, and the spectacular effect of the Engine Shed is of course retained. There is a water tank to supply the locomotives at the Goods Platform end of the locomotive yard.

The platforms of the main station serve both tracks, and are thus available for up and down traffic. The passenger business on the loop line is accommodated at a standard Hornby "Windsor" Station. The platforms of the stations are fully equipped with the usual accessories in the shape of passengers, luggage, milk cans, and different kinds of automatic platform machines. Lineside scenic accessories are fully provided, cattle in the fields, trees, fences and other items being prominent. To complete the effect rural scenery has been prepared, and is attached to the walls, thus forming a suitable background to the whole outfit.

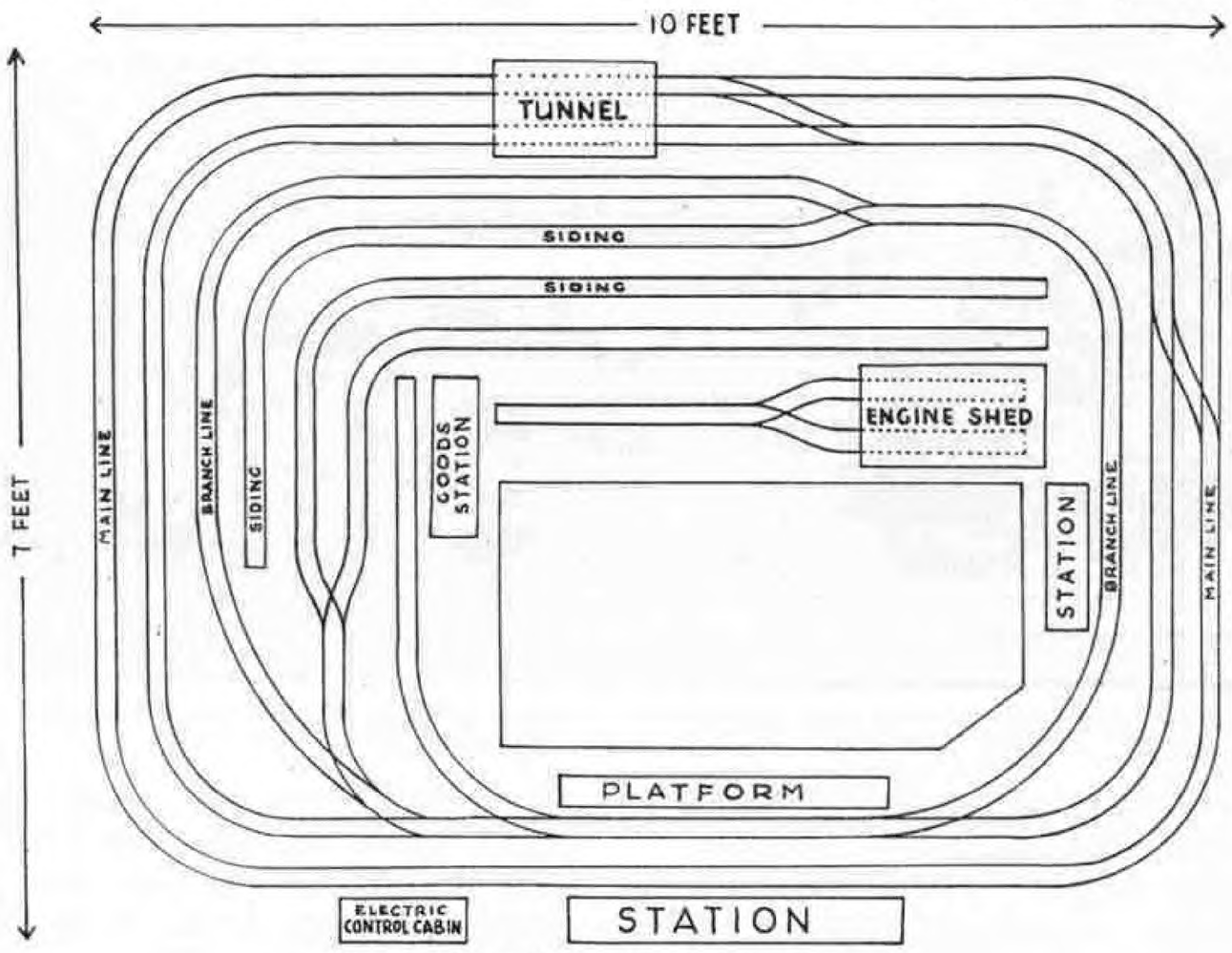


Diagram of the layout described on this page.

The track is signalled in a manner closely resembling actual practice, but the signals themselves are operated individually by hand as required. The signal cabin therefore does not accommodate a lever frame, but it is conveniently made use of to house the Resistance Controller, which regulates the supply of current to the track and so governs the running of the train.

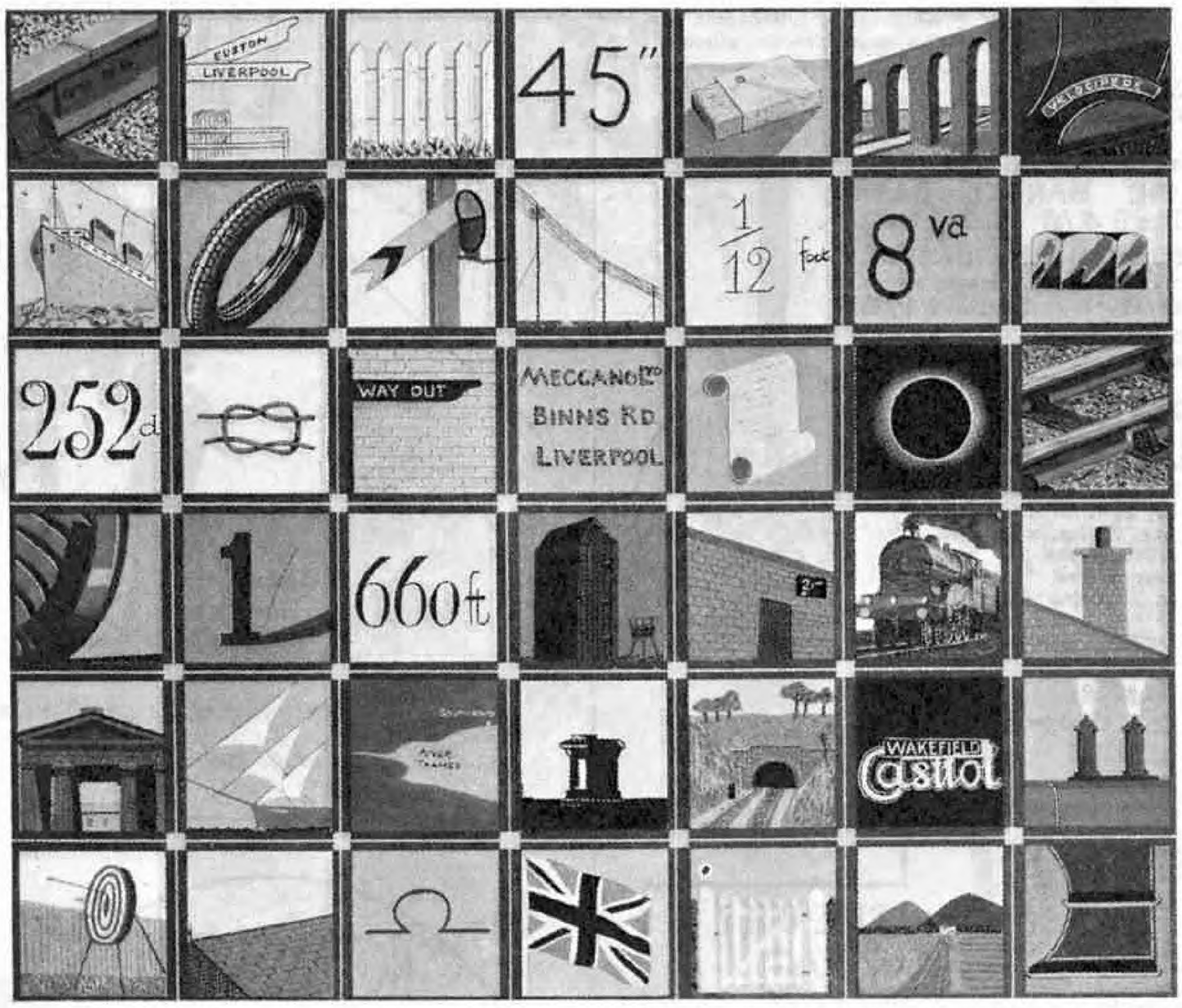
Traffic is operated by three locomotives, each of the Hornby E3 variety. The different prototypes represented are the "Royal Scot" of the L.M.S.R., the "Flying Scotsman" of the L.N.E.R., and the familiar Nord "Riviera" locomotive of the Hornby Series. For passenger services Hornby Pullman Coaches are chiefly used. There is a great variety of goods rolling stock, and the equipment includes a Breakdown Van and Crane.

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Meccano Ltd., Binns Road, Liverpool 13. The name, address and membership number of each competitor should appear in clear writing on the back of every sheet of paper used.

A PICTURE PUZZLE CONTEST

This month we are introducing a new competition that we are sure H.R.C. members will find fascinating and will enjoy solving. It is not a specially difficult contest, but nevertheless it requires sharp eyes and sharp wits, combined with a considerable amount of railway knowledge.



Each of the horizontal sets of pictures on this page represents a seven letter railway word, and each of the letters comprising these words is the initial letter of the subject represented in one of the pictures. For instance, the first picture in the first row shows a section of a railway line in which the most prominent feature is the fishplate. This gives us the initial letter F, which is the first letter of the word represented in this row. The second letter of the word is the initial letter of the subject of the second picture, and so on.

Competitors are required to state the six words indicated by the six rows of pictures, and at the same time to state the subject of each individual picture in order to show how they arrived at each letter.

Prizes of Hornby railway material (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the four competitors in each section, Home and Overseas, whose entries are most correct. In the event of a tie for any of the prizes, preference will be given to the neatest and most novel entry. Every entry submitted to this contest must be clearly marked with the sender's name, full address and H.R.C. membership number.

Envelopes containing solutions must be clearly marked "*H.R.C. May Picture Puzzle Contest,*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 31st May. The closing date for the Overseas Section is 31st August.

Railway Photographic Contest

Last month we announced a new series of Photographic Contests, in which competitors were asked to submit photographs of any railway subject. This month we announce the second contest of the series, in which there are no restrictions in regard to the subject chosen. Competitors may send as many prints as they desire, but no competitor can win more than one prize in one contest.

The Contest will be divided as usual into two sections, Home and Overseas, and prizes of Hornby Train (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded to the senders of the best photographs submitted in each section.

Envelopes containing prints should be clearly marked "*H.R.C. May Photo Contest,*" and posted to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, not later than 31st May. The Overseas closing date is 31st August. Competitors desiring their entries to be returned should enclose a stamped addressed envelope of suitable size. Prizewinning prints become the property of Meccano Ltd.

Drawing Contest

Continuing the series of Drawing Contests that commenced in January, and which are now proving so popular, we announce this month a similar contest, the subject for which is "*A Fogman at Work,*" a familiar sight to all travellers by train during the past winter.

To the senders of the four best drawings received in each section, Home and Overseas, prizes will be awarded consisting of Hornby Train or Meccano goods to the value of 21/–, 15/–, 10/6 and 5/– respectively. The sender's name, full address and H.R.C. membership number must be written on the back of each entry.

Competitors who wish their drawings to be returned should enclose a stamped addressed envelope of suitable size. Entries that gain prizes become the property of Meccano Limited.

Envelopes containing entries must be clearly marked "*H.R.C. May Drawing Contest*" in the top left-hand corner, and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 31st May. Overseas closing date 31st August. A careful note should be made of the closing dates, as entries received late cannot be passed on to the judges.

COMPETITION RESULTS

HOME

February "Locomotive Feature Contest."—First: R. C. Storrar (8625), Letham, Ladybank, Fifeshire, Scotland. Second: E. A. Taylor (25924), North Harrow, Middlesex. Third: K. M. Gilliland (17350), Belfast. Fourth: H. T. Buckingham (23588), Leighton Buzzard, Beds. Consolation Prizes: S. Howarth (21914), Denshaw, Delph, Nr. Oldham; R. B. Williams (35085), Pelaw-on-Tyne, Co. Durham; C. Lloyd (33495), Ormskirk, Lancs.; G. N. Loveridge (26068), Penarth, South Wales; M. O. Mott (30870), Tottington, Bury; K. Costain (5108), Bolton, Lancs.

February "Drawing Contest."—First: W. Dean (35099), Glasgow, S.W.1. Second: A. Marsh (20196), Kates Hill, Dudley. Third: R. A. Lumber (37840), Yeovil, Somerset. Fourth: F. E. Saunders (7989), Folkestone.

February "Voting Contest."—First: W. D. Peach (35063), West Cowes, Isle of Wight. Second: T. Scriven (31842), Merthyr Tydfil. Third: J. J. Horne (17501), Dorn, Moreton-in-Marsh, Glos. Fourth: C. Brett (5868), Great Coates, Lincs. Consolation Prizes: J. S. Taylor (37311), Burnley; H. N. Taylor (16637), Gerrards Cross, Bucks.; B. Lobb (11765) Broadley, Nr. Rochdale; V. Knill (26118), Thorpe Bay, Essex.

OVERSEAS

November "Locomotive Progress Contest."—First: M. L. Morgan (22858), Cremorne, New South Wales, Australia. Second: R. A. Wragg (7913), Bandikui, Rajputana, India. Third: W. J. T. Watson (18065), West Leichhardt, N.S.W., Australia.

November "Layout Planning Contest."—First: H. R. Hondelink (25394), Alkmaar, Holland. Second: P. Chapman (24873), Christchurch, New Zealand. Third: A. A. Tibbitts (24271), N. Rhodesia, S. Africa. Fourth: G. A. Christos (29787), Johannesburg, S. Africa.

GAMAGES

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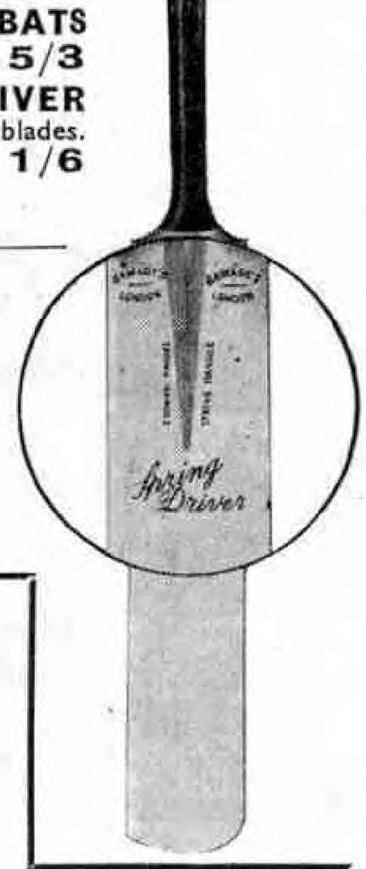
NEW HORNBY LOCOS FOR OLD. Send for leaflet which gives full details of this most attractive scheme

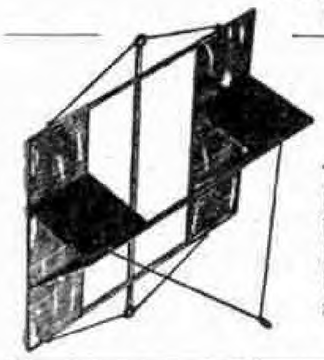
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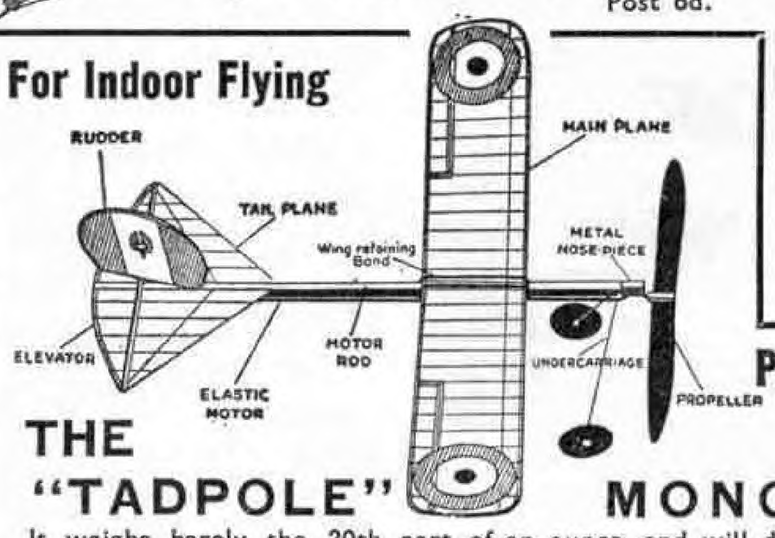




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It takes to pieces—is absolutely waterworthy and will carry a 2½ lb. cargo. Note the large size.



WONDERFUL BARGAINS IN RUBBER BOATS

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"NOWEIGHT" Bluemel's PUMP



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First Steps with a Hornby Railway

The Uses of Curves and Points

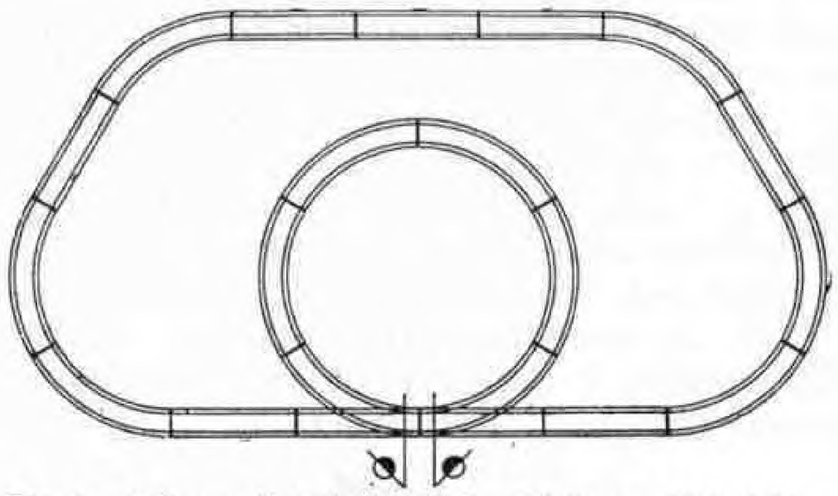


Fig. 4. Rails required (1 ft. radius) : 10 Curves, 7 Straights, Right-hand Points, Left-hand Points.

LAST month we traced the development of a layout from the plain circle and oval forms to different combinations of the two. This month we will explore further the possibilities of other variations of the same general formations.

Fig. 1 is actually a combination of two oval tracks of different sizes, of which one side of the upper or smaller oval also forms part of one side of the lower or larger oval. Let us see how the smaller oval branches off from the larger. Two different kinds of points are used, owing to the differing requirements of their respective situations. Taking the left-hand end of the layout first, it will be seen that, at the end of the length of straight track common to both ovals, the diverging lines are both curved. We therefore require points with both branches curved, or Double Symmetrical Points as they are known.

Although Right-hand Double Symmetrical Points are shown in the diagram, the Left-hand form would fit in the layout, as their track arrangement is the same, but the point lever would come on the opposite side to that shown. The object of including Right-hand Points in this instance is to bring both the point levers in the layout on the same side of the track, for convenience in operation.

Coming to the other place where the two ovals connect, we find that whereas the smaller oval curves away, the main track common to the two ovals remains straight; and an ordinary set of Left-hand Points is thus required. The straight and the curved portions of these points correspond respectively to standard straight and curved rails, so that the points fit without trouble into the layout. The remaining portions of each oval are made up in the ordinary manner with straight and curved rails.

In the next diagram, Fig. 2, we have a different form of layout from any we have so far examined. Up to now the curved portions of our layouts have been complete circles or semi-circles, and the inclusion of these in a plan gives little difficulty. Here, however, we begin to see the effect on a layout of the addition of curved rails, either singly or in pairs. Roughly speaking, the layout in Fig. 2 is triangular in form. Each side of it consists of a single straight rail, and the diagram shows how the sides are connected by curved rails.

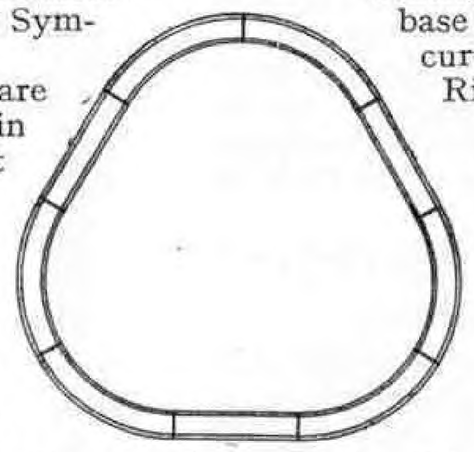


Fig. 2. Rails required (1 ft. radius) : 6 Curves, 3 Straights.

Fig. 3 shows an interesting combination of this triangular form of layout and the familiar oval. The triangular portion branches off in the centre of one side of the oval, where the straight portions of the Right-hand and Left-hand Points form the two middle rails. Their curved portions, which of course are adjacent, form one-third of a circle, which is joined at each end to the straight sides of the triangular formation, as shown in the diagram.

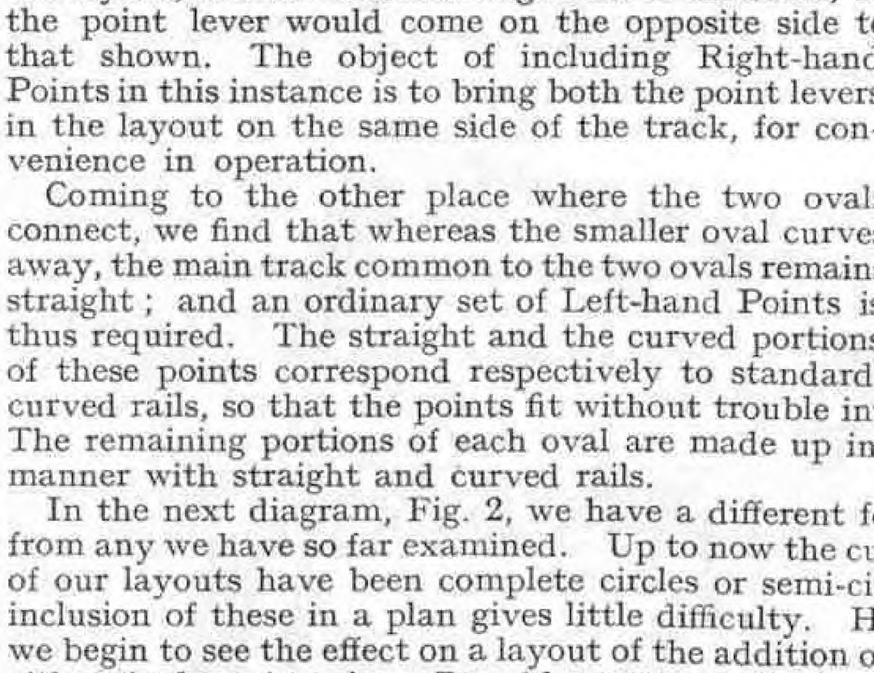


Fig. 1. Rails required (1 ft. radius) : 9 Curves, 9 Straights, Left-hand Points, Double Symmetrical Points, Right-hand.

A development from the triangular form of layout is shown by the main track in Fig. 4. This has been evolved from Fig. 2 by inserting standard straight rails between the two curves at the top. The sloping sides of Fig. 2 are retained, but the base is extended so that it contains the equivalent of one more straight rail than does the top section. As a circle is incorporated centrally, the points by which it is connected form part of the base line of the main layout. The circle is completed by four curves joined on to the curved branches of the adjacent Right-hand and Left-hand Points.

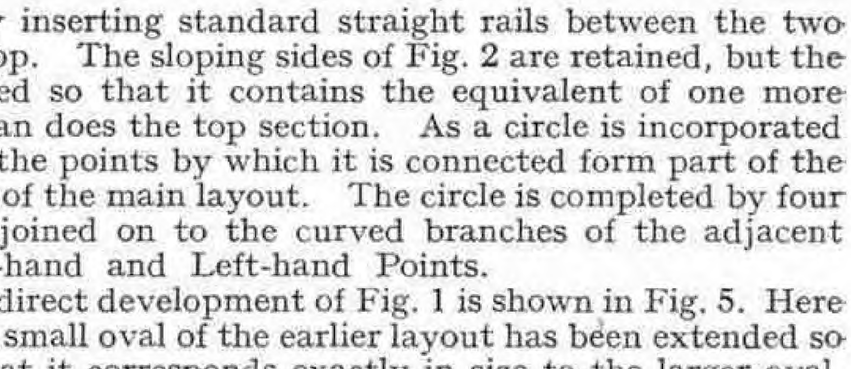


Fig. 5. Rails required (1 ft. radius) : 8 Curves, 12 Straights, Double Symmetrical Points Right, Double Symmetrical Points Left.

A direct development of Fig. 1 is shown in Fig. 5. Here the small oval of the earlier layout has been extended so that it corresponds exactly in size to the larger oval. A further set of Double Symmetrical Points is required, each end of the common central track being thus connected to points of this kind. A slight re-arrangement of the straight rails is necessary for the development of this second layout, which has interesting possibilities for train working.

Where one train only is in use, its route may be changed as required, the whole layout approximating to an exaggerated figure-eight formation with, however, more choice in the matter of the path that the train is to take. With two trains running care must be taken to secure their safe working over the common central track. Possibly they will pass over it alternately in opposite directions, or they may follow one another when both are running the same way. The arrangement of working generally on this layout will be found quite entertaining.

It may be necessary to regulate operations over the common central track by having a token for the section to be carried by every train passing over it. The use of a single token only ensures that only one train can be in the section at once. A Meccano 1″ Rod carried in the tender would be suitable, and its use in this manner would resemble the actual working of traffic over single lines by means of the train staff. A staff applies to one section only and is handed to the driver by the signalman.

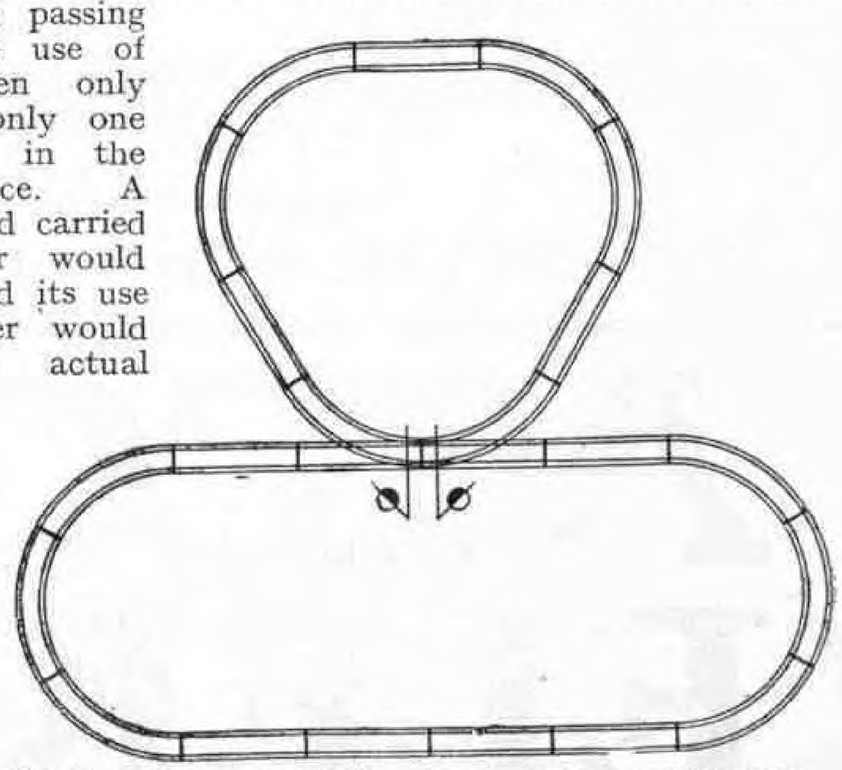


Fig. 3. Rails required (1 ft. radius) : 10 Curves, 9 Straights, Right-hand Points, Left-hand Points.



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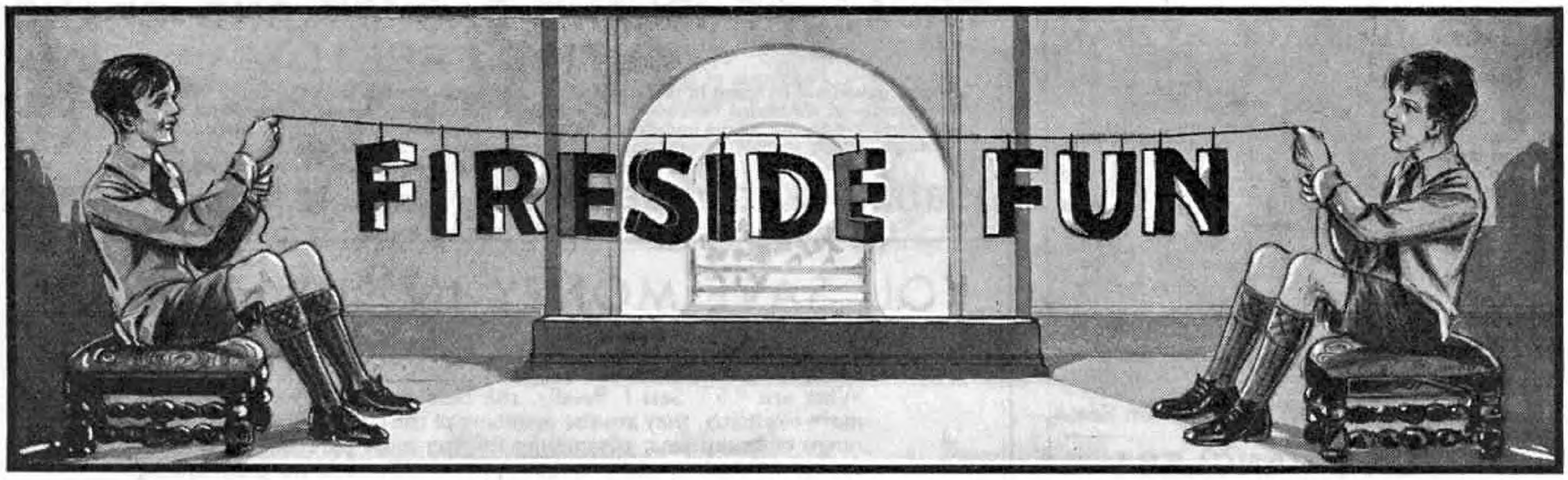
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MECCANO ELEKTRON ELECTRICAL OUTFITS



A SILENT FAREWELL

"They say that money talks."
"That may be, but a lot of mine goes without saying."

* * * *

Young man, entering café: "A ham sandwich, please."
Waitress: "Will you eat it here or take it away with you, sir?"
"Both, thank you?"

* * * *

Rastus: "I ain't gonna run after no more tramcars."
Sambo: "Why not, brother?"
Rastus: "'Cos ah ran after one de odder day, and when ah caught it ah was two stops past where ah wanted to get off!"

* * * *

Explorer: "Once I lived for a year on camel's milk."
Listener: "Didn't it give you the hump?"

* * * *

Small Boy (to absent-minded Professor): "Your hat is on the wrong way, sir."
Professor: "How do you know which way I'm going?"

* * * *

"Why do you call your dog 'Hiker'?"
"Because he goes for tramps!"

* * * *

Mother: "Are you sure it was an accident when you hit Willie on the nose?"
Henry: "Yes, ma! I aimed for his eye!"

* * * *

"Which of us is to wait for the other?"
"The one who gets there first."

* * * *

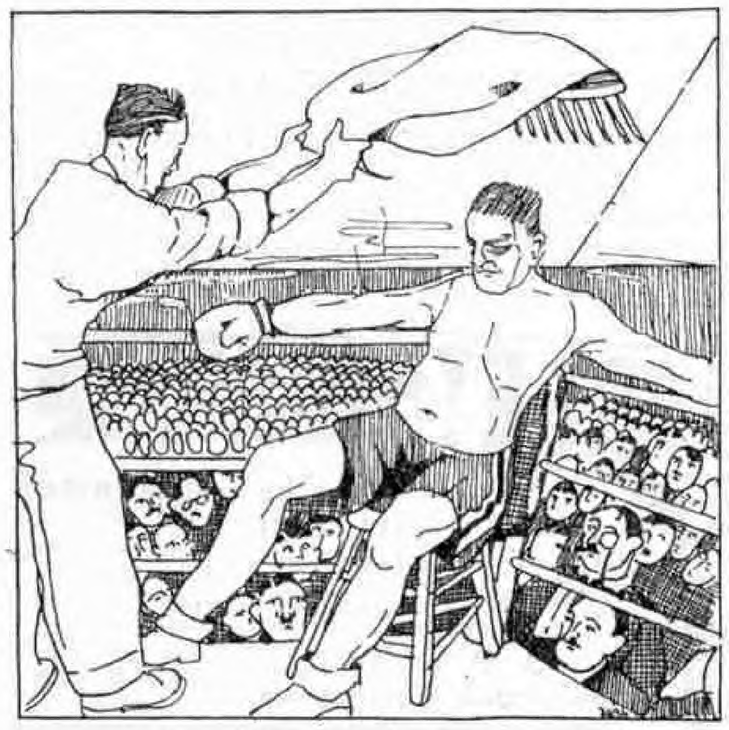
The lion-tamer was rehearsing some of his charges when an attendant approached the enclosure.
"The Income Tax man would like to see you, sir," he announced.
"Very good," replied the lion-tamer. "Show him right in."

* * * *

Father (sternly): "Worse and worse! Now you are last in the class instead of last but one."
Son (sadly): "But, dad, I can't help it if the bottom boy is ill."

* * * *

MISPLACED KNOWLEDGE



Trainer (reassuringly): "You'll get 'im in the next round. Why I could get all he knows about boxing in my eye, and not notice it."
Boxer: "I wish he wouldn't keep on putting it in mine."

* * * *

"Your new overcoat is very loud."
"It's all right when I put on a muffler."

WORTH TRYING

"Willie," said the Sunday School teacher severely, "you shouldn't talk like that to your playmate. Have you ever thought of heaping coals of fire on his head?"
"No, I haven't," said Willie, "but it's a great idea."

* * * *

Teacher: "What is a fish-net made of, Williams?"
Williams: "A lot of little holes tied together with string."

* * * *

The motorists were not at all sure of their whereabouts.
"Why not stop and ask someone where we are?" suggested one.
"What's the use?" said another. "In ten minutes' time we shan't be anywhere near here."

* * * *

"TOP"-IARY!



Unfortunate lapse on the part of the barber whose hobby was clipping shrubs into ornamental shapes.

* * * *

"Does the giraffe have a sore throat if it gets its feet wet?"
"Yes; but not until the following week."

* * * *

"Do you know how to find out the weight of an elephant?"
"No."
"Put your toe under its foot!"

* * * *

Two youths who were walking in the Cumberland hills stopped to talk to an old villager.
"A wonderful view you have from here," said one of them.
"Yes," broke in the second, thinking he would tease the old man. "I expect you can see across to America sometimes."
"Much farther than that," was the reply. "Why, when there's no mist we can see to the Moon."

* * * *

"My office boy always whistles while he works."
"You're lucky. Mine only whistles."

* * * *

"Sir, your car is at the door."
"Yes, I know; I hear it knocking."

* * * *

An old man from the country stopped in front of a cinema plastered with posters of lions, tigers, elephants and other wild animals.
"Henry!" he said to his nephew, who lived in town, "I'm glad I'm going home on Saturday afternoon."
"Why?" asked the nephew.
Pointing to the notices, the old man read: "To be released on Saturday night."

* * * *

First One: "His singing is heavenly."
Second One: "It certainly is unearthly."

A HEALTHY DISTRICT!

"In the past five years only one man has died here, and he was the doctor," said the local estate agent to a prospective house purchaser.
"What did he die of?"
"Starvation."

* * * *

"Have you ploughed your big field yet?"
"No, not yet. But I'm thinking of doing so."
"Oh, I see. You've only turned it over in your mind."

* * * *

Captain: "Have you cleaned the deck and burnished the brass?"
Seaman: "Ay, ay, sir; and I've swept the horizon with a telescope."

* * * *

Footpad: "What time is it, guv'nor?"
Gentleman: "Eleven o'clock, my man."
Footpad: "I'll never remember that; lend us yer watch!"

* * * *

"A burglar broke into our house last night, and he had the cheek to have a bath before he left."
"Did you catch him?"
"No! He made a clean getaway."

* * * *

Sailor: "We've sprung a leak below, sir!"
Captain: "Well, go and tell the cook to put it in the soup!"

* * * *

The Irishman, who had been thrown over a fence by an enraged bull, was just recovering from his mishap when he noticed the bull pawing the ground and tossing its head.
"Shure, an' if it wasn't for your bowing and scraping," said Pat, "I'd just think yer threw me over on purpose!"

* * * *

First Tramp: "Wotcher lookin' so miserable about, eh?"
Second Tramp: "Why, I just found a recipe for home-made cake, and I ain't got no home!"

* * * *

Customer: "Why have you raised your charge for shaving in these hard times?"
Barber: "Well, sir, the depression has made peoples' faces longer."

* * * *

A TACTICAL RETREAT



"Turn round and fire, you idiot."
"No fear. The earth's round and I'm getting into position to attack from the rear."

* * * *

The diner was not at all satisfied.
"Waiter!" he called, "are you sure this fish was cured?"
"Yes, sir, quite sure," was the reply.
"Well, it's had a relapse."

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5	Honduras ...	2d.	10	,, ...	5d.
10	,, ...	5d.	5	Cuba	2d.
15	,, ...	8d.	10	,, ...	5d.
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PICTORIALS!!!
80 STAMPS 6d.

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Once again I am offering this wonderful packet. It contains more stamps than ever. **35** fine Orientals with mosques, minarettes, domes and eastern views. Set of **EGYPT, SYRIA** (pictorial), set of **4 TUNIS,** a fine new issue **LATAKIA,** set of **PALESTINE** (mosque, etc.), **AFGHANISTAN** (new issue), set of **FRENCH MOROCCO** (Arab buildings, fine pictorials), **2 SOMALILAND** (new issue), **GRAND LIBAN,** set of unused **ALGERIA,** fine **MECCA,** pictorial **IRAQ,** and a wonderful set of **10 TURKEY,** including pictorials, towers, minarettes, etc. (usually sold at 1/-. Price **4½d.** Postage **2d.** extra, abroad **3d.** extra). **PURCHASERS** of this packet asking for approval sheets will receive **FREE** a unique set of **10 PERSIA,** usual price **1/6.** Money returned if not satisfied. Senders of addresses of stamp collecting friends receive an additional set **FREE.** BARGAIN OFFERS: **20 AIR POST 6d., 100 BRITISH COLONIALS 1/-.**
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10 PERSIA FREE





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FREE! TO STAMP COLLECTORS

I will send this splendid packet to all Stamp collectors sending 2d. postage only.

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20 STAMPS all different, from the French Colonies, showing natives, leopards, jungle scenes, etc. Handsome Pictures.





ERRORS AND VARIETIES

In our last issue we discussed the " errors " and " varieties " that arise in the designing and printing of a stamp. Those processes in stamp production are not the only source of error, of course; differences in ink, paper, watermark and perforation quite commonly provide them. Indeed, printing ink probably has been responsible for more heartburning over stamp errors than any other cause.



Genuine errors of colour are important and are keenly sought by collectors, but many different " shades " of colour are the outcome of chemical action on the ink, not of the use of a wrong ink or careless mixing of the right ink, or too heavy or too light a pressure in the printing press. Considerable care must be taken to establish the *bona fides* of any so-called error of colour before it is accepted as genuine.

Some years ago a most extraordinary range of shades was found among stamps used in a certain region in Persia, but enquiry revealed that the changes were due to chemical fumes from neighbouring oil wells!



As we have said, different shades of colour are interesting, but it should be kept in mind that their importance, outside the field of genuine error, lies in their indication of the different printings from which the various stamps have been produced. The collection of " shades " is specialism of an advanced nature, and the young collector would be well advised to ignore all but very marked " varieties."



Paper errors are limited to a very few types. The use of one type of paper instead of another has been known, but in a well-organised stamp-printing works the paper is so carefully checked that a mistake of this nature is almost impossible. When it does occur a first-class error is created. Distinct differences in the thickness of the paper used for a particular stamp that has been on issue over a long period may be noted, but unless the differences enable a collector to put definite dates upon the issue of the particular varieties, the interest of the specimens is small. Where the differences are very marked, the stamps of course should be retained.

Occasionally slight differences in size may be detected between line-engraved stamps of the same type. They arise from the fact that in printing from line-engraved plates it is necessary to damp the paper slightly before use. If the damping is carefully done, all the sheets will shrink evenly when drying and all the stamps will be of the same size; but if the damping is done carelessly the degree of shrinking is bound to vary, and there will be slight differences between the size of the reproductions in that batch of sheets. This variety is not of any importance, however, and may safely be ignored.



The important " paper " errors are almost entirely confined to watermarks, but here also not all the varieties are of interest. The watermark, as most of our readers know, is a preventive device against forgery, worked into the texture of the printing paper during manufacture. Usually it appears in the sheet right way up with the stamp design, but inverted watermarks and watermarks on their side are so commonly to be found, as a consequence of some particular feature of the stamp printing, that they are no longer regarded as of importance. Among certain Australian issues, for example, watermarks are to be found inverted as frequently as right way up. Again, in the printing of stamps intended to be made up in booklets, the particular system of folding necessitates printing one half of the sheet inverted in relation to the other half. Obviously half the stamps will have their watermarks inverted.



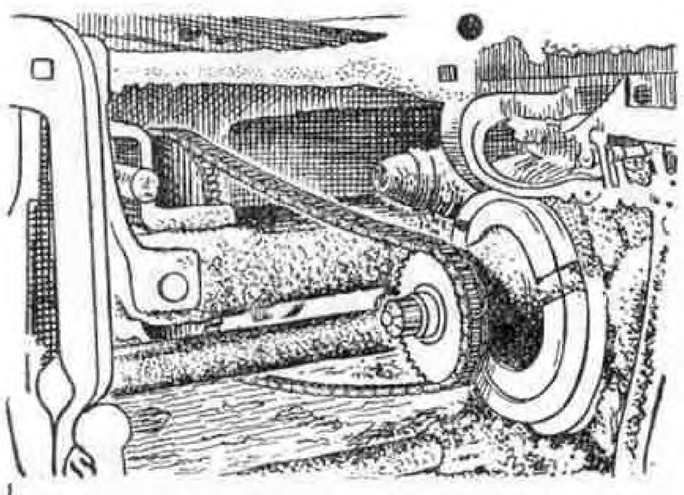
The most important watermark variety is that created by the printing of a stamp on paper bearing the watermark allotted to another issue. An outstanding example of this error is to be found in the 1d. red Transvaal stamp, bearing King Edward's portrait, issued in 1905. This is on paper bearing the " Multiple Crown C.A." watermark normally, but it is also known on paper reserved for Cape of Good Hope issues, with an anchor device for watermark.

Occasionally it may happen that a sheet of unwatermarked paper finds its way into a supply of watermarked paper. How that comes about cannot be explained satisfactorily, but it has occurred among British stamps in modern times, despite the stringent precautions that are always taken by the printers. Such an error is important, but careful distinction must be drawn between it and another form of " no watermark " error. In many cases sheets of stamps have margins of blank paper round their edges and between their sub-divisions. As it would be undesirable to give them the ordinary watermark—forgers are ever alert for such opportunities—these margins sometimes are watermarked differently from the remainder of the sheet, and sometimes not at all. If by chance a sheet of the paper is fed into the press too much to one side, the marginal space will be printed upon, and if the width of the margin is equal to that of a stamp, an apparent " watermark " error will be created.

Marginal watermarks are rarely mentioned in the catalogues, and a variety created in this way may cause much confusion. It has no interest except as a curiosity, however. It will be obvious that it is desirable to collect watermark " errors " in strips or blocks so that sufficient of the paper may be shown to prove that the error arises in the sheet and not merely in the printing.



Lastly we deal (*Continued on page 429*)

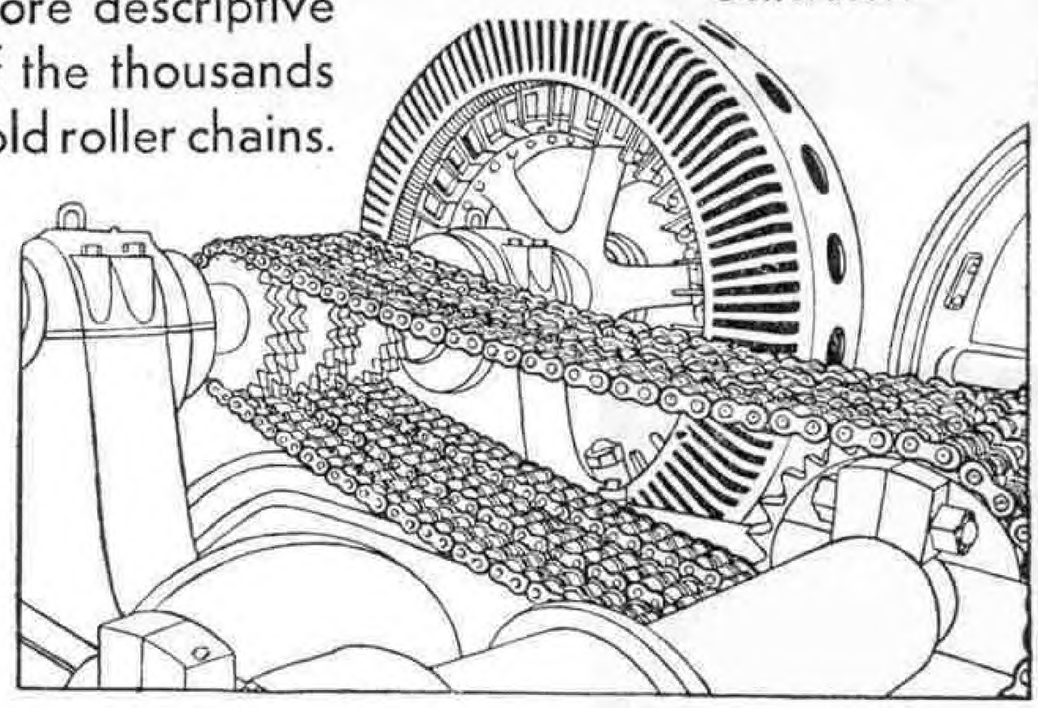


This drive transmits about one horse power to train lighting set dynamos on the Canadian National Railways.

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A fine packet of all different Stamps containing **Manchukuo,** 1932 ½ fen pictorial, **French Indo China Air Mail,** unused, **Eritrea,** 1930 2c., large pictorial **Somali Coast, Tunis** 1933, new issue, **Turkey** pictorial, **Brazil** pictorial, **Nigeria, Portugal, Ceylon,** etc., free to all asking to see my famous Approval Sheets and enclosing **2d. for postage. (Abroad 6d. P.O.)**
Albums, **1/4, 2/6, 5/–** and upwards.
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CUT YOUR STAMPS IN TWO!

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Contains **500 Excellently Assorted Foreign Stamps, 25 B. Colonials** (catalogued at 2/–), a complete sheet of **100 Unused** (useful for exchanging), **375 Strip Mounts** which mount stamps three times as quickly as any other method, a **12 Page Duplicate Book** (to hold 120 stamps). The lot **5d.,** postage 2½d. (abroad **6d.** extra). Ask for Approvals. Senders of collectors' addresses receive **10 Persia Free.**
H. C. WATKINS (M. DEPT.), GRANVILLE ROAD BARNET. *Your money back if not satisfied.*

For further Stamp Advertisements see page 440.

Stamp Collecting—(*Continued from page 427*)

with errors of perforation—the least popular form of varieties. The principle items of interest lie among the "imperforate" varieties, but particular care must be taken with older issues that normally possess wide margins, to ensure that the imperforate "error" has not been produced by the simple process of clipping off the perforation teeth with scissors. To guard against this danger many collectors will collect imperforates only in pairs.

The principal causes of modern "imperforate" errors lie in the missing of a stroke of the perforating machine. There are two machines commonly in use, the "line" and the "comb." The "line" machine perforates one row of holes at a time. If a stroke is missed two rows of stamps will be left with an imperforate margin between them, unless the missing stroke happens to be on the outside edge of the sheet, in which case only the outer edge of one row of stamps is affected. Some countries deliberately omit to perforate the outer edges of the sheets, with the result that the corner stamps are imperforate on two sides, and the remainder of the outside stamps are imperforate on one edge. These varieties are known as "straight edges," and because they are deliberately created they are not popular with collectors. That is an interesting little sidelight on philatelic whims, for in the ordinary operation of the law of supply and demand, the "straight edges," being less common than the standard type, would be more eagerly sought.



The "comb" machine perforates three sides of the stamp at each blow, and the missing of one blow would leave a row of stamps each with three imperforate sides, except on the outside edge where only the back of the comb is engaged in perforating the stamp divisions, the teeth at that point being concerned only in piercing the marginal paper.

As Mr. Stanley Phillips comments in his book "*Stamp Collecting*," to which we are indebted for many of the interesting points in this series of articles, it is another curious example of the freakishness of philatelic taste that, although double prints and surcharges receive considerable attention, double perforations are comparatively ignored. Such varieties, showing clearly the two strokes of the perforating machine, are not infrequently found. Except that they permit of the identification of different printings in a long-lived issue, perforations are only of consequence to the specialist collector.



Stamp Gossip

and Notes on New Issues

The Belgian Mourning Stamp

As part of the national mourning for the late King Albert, Belgium has issued a special mourning stamp. The value chosen is the 75c., which is the most frequently used for internal correspondence, while a pair will prepay the Postal Union rate for Overseas correspondence. Normally the 75c. is printed in brown, but the mourning stamp is in black, including a black border surrounding the outer frame and covering the perforation teeth.

* * * * *

Poland has celebrated the 15th anniversary of independence by the issue of the 30 gr. stamp illustrated on page 427. Its interesting design shows the "Cross of the Order of Independence," founded seven years ago by Marshall Pilsudski to honour those who signally promote their country's cause. The cross has been lavishly bestowed on people in all walks of life, from artisans to aristocrats, but strangely enough the most distinguished Pole of all, Paderewski, the pianist-president, has not been decorated.

* * * * *

To commemorate the ill-fated record-breaking ascent into the stratosphere by the Russian balloonists Fedossejenko, Wassenko and Ussyskin, the U.S.S.R. has issued a short series of stamps bearing the design illustrated here. There are three values, 5k., 10k. and 20k. The stamp makes an interesting companion for the Belgian Piccard issue of September, 1932.

* * *

We illustrate here one of the two designs used for the Egyptian series commemorating the tenth Congress of the Universal Postal Congress at Cairo. It shows a portrait of Ismail Pasha, Khedive of Egypt from 1863 to 1879, and father of the present King Fouad. Ismail Pasha was the founder of the present Egyptian Postal system, which was inaugurated in 1866.



Another Olympiad Issue

The Tenth Oriental Olympiad that is to take place this month at Manila, in the Philippine Islands, is to be commemorated by a special series of stamps. There will be three stamps in the set, 2c., 6c. and 16c. values, with designs showing action pictures of a baseball batter and catcher, a tennis player, and basketball players. This Olympiad is held in the Philippines every ninth year, and this year athletes from China, Japan, Indo-China, Siam and India will compete with those from the Philippine Islands.

New German Air Issues

The new German air series makes an interesting addition to the range of stamps illustrating the history of aviation. For the nine low values, 5 pf. to 100 pf., one design only is used, showing the German eagle flying across the globe, from behind which a swastika marked sun is rising. For the two high values, as our illustrations show, we are given portraits of Otto Lilienthal and Count Ferdinand Zeppelin on the 2M. and 3 Rm. values respectively.



Lilienthal was one of the pioneers of gliding, and his discovery of the advantage of the curved wing over the flat was undoubtedly the most important aeronautical discovery up to his day. Lilienthal lost his life in August 1896, while gliding. The design of the stamp shows in the background one of his curiously shaped gliders.

Count Zeppelin was a soldier and not a scientist, and although he had been interested in the problems of lighter-than-air vessels for many years, he did not devote himself to the subject until he retired from the German Army in 1891, at the age of 53. In 1906 came his first successful flight of 60 miles in two hours, and as a result of this flight the famous Zeppelin Company was formed with the backing of the German Government. The remaining history of the development of Zeppelin airships is too well known to need recounting here. Count Zeppelin himself lived to see his aircraft used in wartime operations.

We illustrate also the new German official stamp. The same design is used for each of 12 values, 3 pf. to 50 pf., comprising the issue.

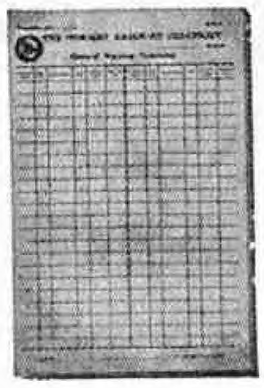
Beautiful African Pictorials

Many beautiful and interesting stamps have come from Africa in recent years, but even the best of the Italian Colonials will find it hard to outshine the pictorials newly issued by Spanish Morocco.

We illustrate the design of the 40c. and 50c. values, showing the Market Place at Larache, the site of the Garden of the Hesperides. The other stamps, 10c., 20c. and 30c. values, show Arab scenes at Xauen and Tetuan.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made

Hornby Railway Company Forms



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Please quote membership number when ordering supplies.

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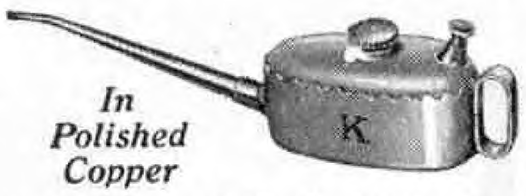
MECCANO LUBRICATING OIL



Before commencing to operate a Meccano model, or to run a Hornby Train, all gears and bearings should be oiled thoroughly with Meccano Lubricating Oil. This oil is specially prepared and is of the right consistency for the purpose. Price per bottle 6d.

Meccano Ltd., Binns Road, Liverpool 13.

OIL CAN No. 2 ("K" Type)



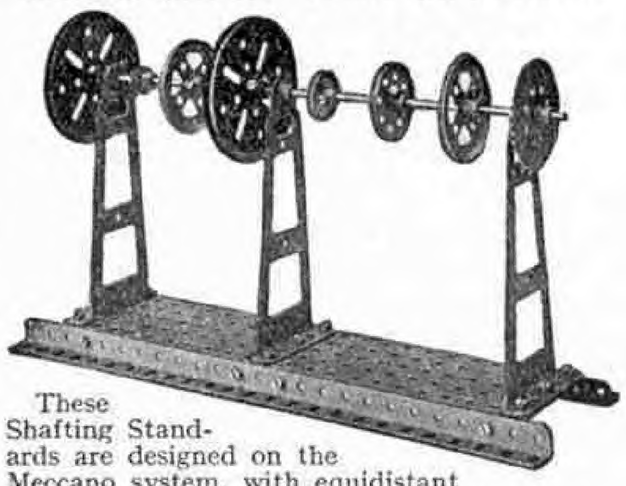
In Polished Copper

Every Meccano and Hornby Train enthusiast should add a miniature "K" type oil can to his equipment for the purpose of oiling Meccano models, Hornby Trains, etc. The oil is ejected drop by drop by depressing the valve, as in the full-sized model, and in all other respects the oiler is perfect.

One of the oil cans was sent to H.R.H. the Prince of Wales, and a gracious letter of acknowledgment was received expressing H.R.H.'s admiration of the beautiful lines and perfect finish of this model. Price 3/6

Meccano Ltd., Binns Road, Liverpool 13.

MECCANO SHAFTING STANDARDS



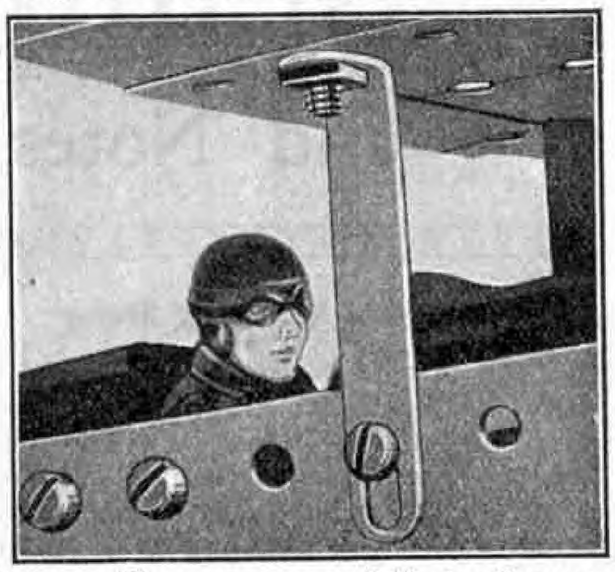
These Shafting Standards are designed on the Meccano system, with equidistant holes. Our illustration shows how strong and serviceable shafting may be constructed from Meccano parts with the aid of the Large Standard.

Standard only, Large (Part No. 177) Price 1/–
" " Small (" " 178) " 8d.

Meccano Ltd., Binns Road, Liverpool 13.

Miniature Aeroplane Pilots

Aeroplane Parts Nos. P99 and P100



Miniature Pilots are now available for fitting to all open cockpit machines built with the Nos. 0, 1 and 2, and 1 and 2 Special, Meccano Aeroplane Constructor Outfits. These attractive little figures, which add a wonderful touch of realism, can be obtained in three different styles—with green coat and orange cap, blue coat and red cap, or red coat and green cap.

Aero Part No. P99, which is suitable for fitting to the No. O Outfit models, is fixed to a special bracket that takes the place of the Propeller Shaft Bracket in the Outfit. The special bracket is secured by passing bolts through the sides of the fuselage into the threaded holes in the bracket. The Propeller Shaft rests in the bearing socket formed in the Pilot's body.

Part No. P100 (illustrated above) is used in Nos. 1 and 2, and 1 Special and 2 Special Outfit models. The Pilot is fixed to a double angle bracket ready for bolting to the sides of the fuselage.

Prices :

P99 Aeroplane Pilot ... ... each 5d.
P100 " " ... ... " 5d.

Meccano Ltd., Binns Road, Liverpool 13

Wear a "MECCANO ENGINEER" BADGE

You know how easy it is to distinguish the judges and stewards at an exhibition or show. Their badges show at once who they are. In the same manner, boys who wear a "Meccano Engineer" badge are recognised by all other boys as Meccano model-builders, keen on their hobby and proud to let everyone know they are keen.

If you are a model-builder get a "Meccano Engineer" badge to-day, price 2d. from your dealer, and wear it on all occasions. It is very attractively finished, and the design, which exemplifies Progress in the World of Engineering, is particularly pleasing.

Meccano Ltd., Binns Road, Liverpool 13

How to obtain the "M.M."

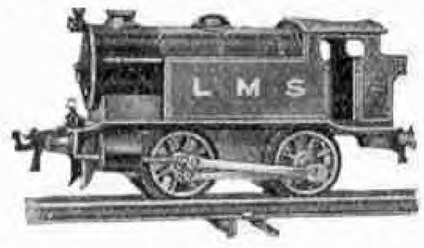
The "*M.M.*" may be ordered from all Meccano dealers, or from any newsagent or bookstall, price 6d. per copy. Direct subscriptions to this office will be at the rate of 4/– for six, or 8/– for twelve issues. As a rule, back numbers cannot be supplied, because we print only sufficient copies to fill our standing orders. To prevent disappointment, therefore, place a regular order either with your dealer, newsagent, or direct with this office.

Meccano Magazine, Binns Road, Liverpool 13.

This Space is set to ½ inch s.c. and costs 8/– per month. The sum is the 50th of £20, the price of a whole page advertisement. Over 70,000 copies of the April number were distributed all over the world. You can therefore sell to this exclusive public for approximately one penny a thousand.

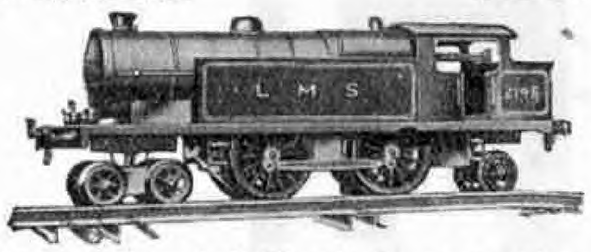
Gauge 0

HORNBY TANK LOCOMOTIVES



No. 1 Tank Locomotive

A strong and durable Locomotive, capable of any amount of hard work. It is fitted with brake mechanism and reversing gear. Supplied in L.M.S.R., L.N.E.R., S.R., or G.W.R. colours. Price **13/6**



No. 2 Special Tank Locomotive

This model is fitted with a powerful Clockwork mechanism, giving great length of run. Finished in the colours of the L.M.S.R., L.N.E.R., G.W.R. and S.R. Price **25/–**

Meccano Ltd., Binns Road, Liverpool 13.

MECCANO ENAMEL



Meccano enamel has been introduced to enable model-builders to convert nickel parts to colour or to touch up coloured parts should such treatment become necessary through mishandling. It is available in red, grey or green, each colour being identical in shade with the enamels used in the Meccano Factory for spraying Meccano parts.

Price per tin 8d.

Meccano Ltd., Binns Road, Liverpool 13.

"MECCANO MAGAZINE" SPRING BACK BINDER

There is no better way of keeping your Magazines clean and tidy than by binding them in one of the special binders we supply.



These binders have strong stiff backs, covered with black imitation leather, tastefully tooled, and are lettered in gold. The large binder holds 12 Magazines — price 3/6 post free. The small binder holds 6 Magazines — price 2/6 post free.

Meccano Ltd., Binns Road, Liverpool 13.

H.R.C. WRITING PADS

Every member of the Hornby Railway Company should make a point of using the special H.R.C. writing paper for correspondence with his friends and with Headquarters. It is available in two sizes and is supplied in pads, each consisting of 50 sheets of superfine buff paper, and cover.

Prices—Large Size 1/– each (post free). Small Size 6d. each (post free).

ENVELOPES

Special envelopes, attractively printed and matching the writing paper in colour, are also available. These are suitable for both the large and the small sheets of writing paper.

Price, per packet of 50, 8d. post free.

Meccano Ltd., Binns Road, Liverpool 13.

Competition Corner

A MAGAZINE JIG-SAW CONTEST

The Advertisement Jig-Saw puzzle in our December issue enjoyed an amazing popularity, but it had one serious defect—it was too easy for our sharp-eyed readers! Nearly 400 competitors succeeded in arriving at the correct solution. This month's competition, although of the same type, will, we believe, provide a stiffer test.

Our illustration contains 16 fragments, all different in shape, but all equal in area, and consisting of four of the small triangles. These fragments have been cut from various parts of this month's "*M.M.*", and both the advertisement and the literary pages are represented.



The four triangles of each fragment are not linked together in the illustration. They have been separated and distributed to various points in the picture. The task our readers are set is to identify and assemble the small triangles in their correct positions, and thus re-build the 16 fragments. When this has been done correctly the 16 fragments can be made to interlock as in a jig-saw puzzle, and will form a perfect square.

Although competitors will have to search carefully through the magazine to locate the fragments, the task will not prove too teasing, for where one triangle is found there will be found the other three, the four being joined together. The triangles are reproduced exactly the same size as they appear in the magazine itself.

Readers are asked, first, to indicate the pages or, in the case of advertisements, the advertisement from which the fragments are taken, and second, to indicate the positions of the 16 fragments in the completed square.

It is not necessary for readers to cut up their magazines to fulfil the requirements of the competition. Instead a copy of the square should be prepared in blank and numbered in accordance with the key plan given in the middle column at the foot of the page. After the fragments have been located and pieced together, their positions in the completed square may be indicated simply by quoting the reference letters and numbers in the key plan below. To explain how this may be done we may state that one of the fragments will occupy triangles numbers F2, F4, J1 and J4.

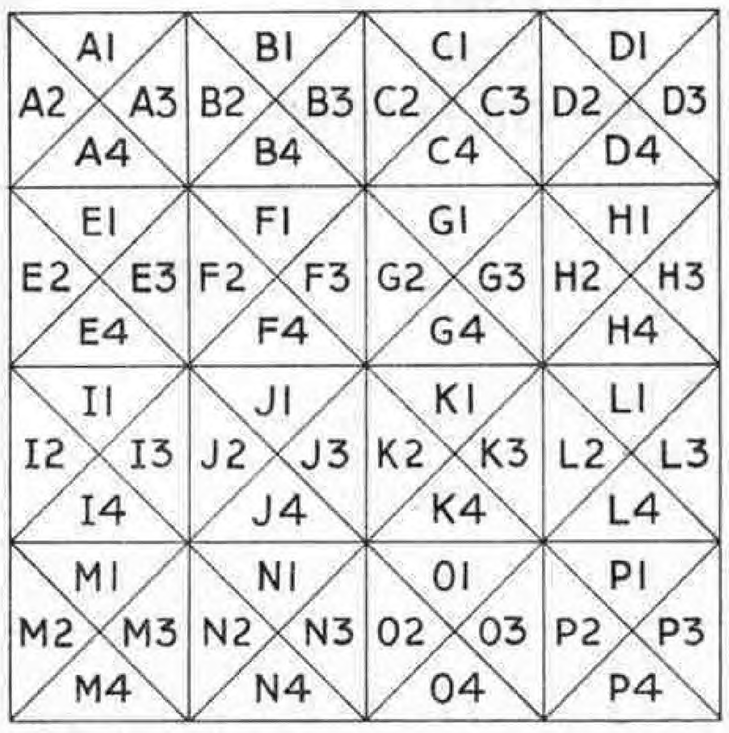
Prizes of Meccano Products to the value of 21/–, 15/–, 10/6 and 5/– will be awarded to the senders of the four most accurate solutions in order of merit. Entries must be addressed "Magazine Jig-Saws, Meccano Magazine, Binns Road, Liverpool 13," and must reach this office not later than 31st May. Overseas closing date, 31st August.

May Photo Contest

As announced in our last issue, our photographic contests this year are again open to photographs of any subject and size, made with any make of camera, plate, film or paper. The exposure must have been made by the competitor, of course.

Each month's competition will be divided into two groups, Home and Overseas, and in each of these groups there will be two sections, A for those aged 16 and over, B for those under 16. Prizes of Meccano Products or Photographic Materials to the value of 21/– and 10/6 will be awarded in each section.

Entries sent this month must be addressed "May Photo Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 31st May. Overseas closing date, 31st August.



COMPETITION RESULTS

HOME

March Drawing Contest.—First Prizes: Section A, L. R. Litler (Northwich); Section B, A. Wallace (Dundee). Second Prizes: Section A, D. B. Tansley (Bishop's Stortford); Section B, W. Law (Congleton).

Cover Voting Contest.—1. "M.M." Reader (Copthorne); 2. R. Gardner (Leeds); 3. C. Relf (Heathfield); 4. G. Masterson (London, E.11). Consolation Prizes: H. Cunningham (Belfast); J. S. Daber (Salford); P. Edridge (Chesterfield); W. Holmes (Kilbarchan); P. Lambert (West Worthing); R. Laws (Littleport); F. Olver (Widnes); K. N. Smartt (Chesterfield); J. S. Thorp (Grantham); C. Weatherbed (Richmond, Sheffield).

Slogan Contest.—1. R. Tilley (South Ealing, W.5); 2. A. Veeder (Cowes); 3. H. Cuff (Morden); 4. G. M. Jones (Lanark).

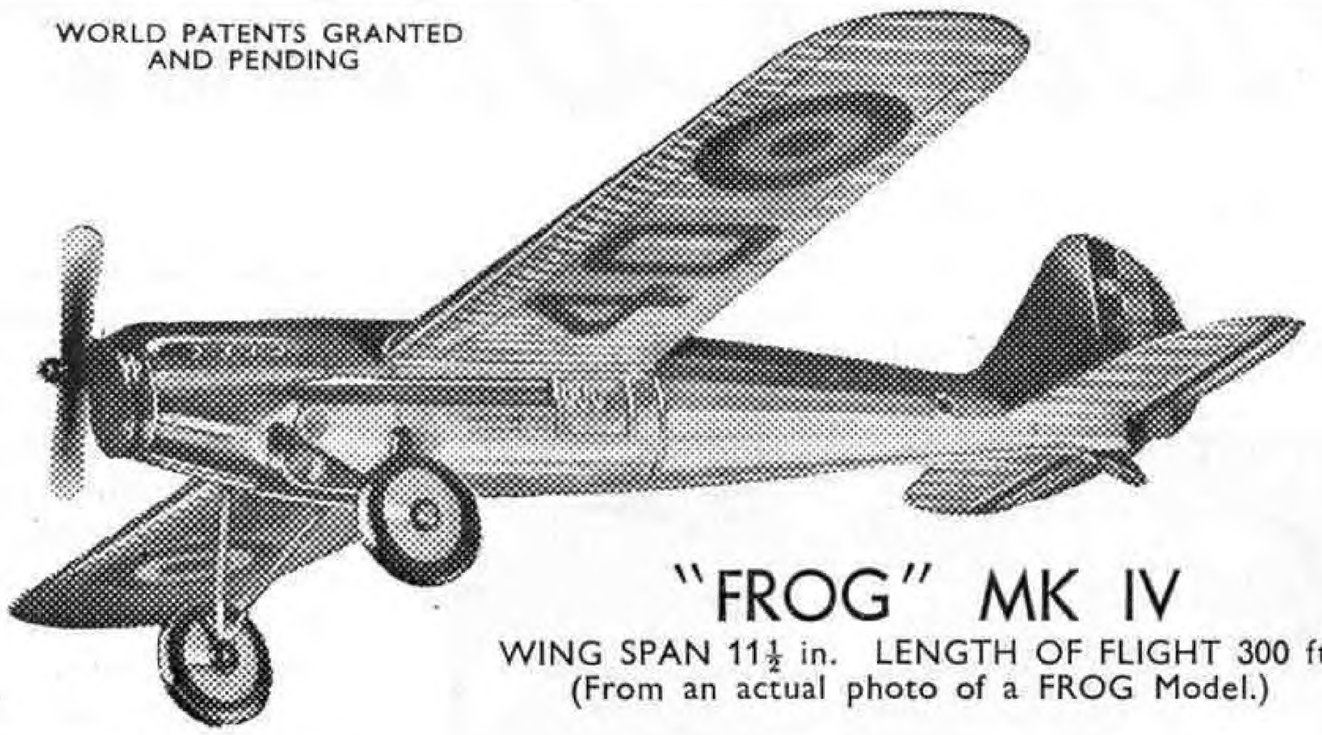
OVERSEAS

December Drawing Contest.—First Prizes: Section A, W. Figgins (Timaru, N.Z.); Section B, W. Jones Winnipeg). Second Prizes: Section A, N. Soderberg (Falun, Sweden); Section B, R. Conly (Dunedin).

Advertisement Jig-Saw.—1. L. Protti (Milan); 2. G. J. Jonker (Theunissen, S. Africa); 3. J. A. Oleaga (Buenos Aires); 4. F. Lockie (North Auckland).

FROG *FLYING SCALE MODEL* AIRCRAFT

WORLD PATENTS GRANTED AND PENDING



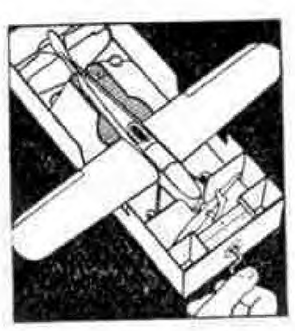
The original and now famous model. A scale model of a high-speed Monoplane. Tubular construction, patented quick detachable fittings. High efficiency air-screw. A splendid machine for realistic stunting. Watch it zoom, loop and "barrel roll." Made with the correct markings and in the full colours of seven nationalities. British R.A.F., Italy, France, Holland, U.S.A., Belgium and Argentine.

"FROG" MK IV

WING SPAN 11½ in. LENGTH OF FLIGHT 300 ft.
(From an actual photo of a FROG Model.)

PRICE
7/6
Complete with spare motors, lubricant and gear box oil, patent high-speed winder box and illustrated flying manual.

Attractive coloured transfers of famous R.A.F. squadron markings for wings and fuselage. Easily applied.
1/6 per set



The FROG AND PUSS MOTH can be quickly wound for flight with the patent high-speed winder box in which each model is packed.



From an actual photo of a FROG PUSS MOTH Model.

TRADE MARK REGD.

PUSS MOTH

WING SPAN 18 ins. LENGTH OF FLIGHT 600 ft.

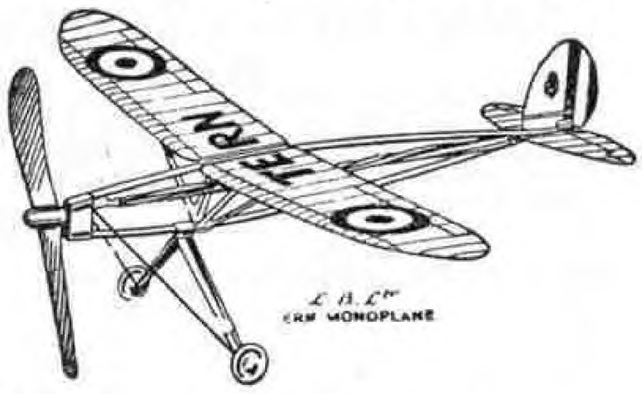
A magnificent scale model of the famous record-breaking light aeroplane. All metal fuselage with bulkhead reinforcement, hollow wings of special design and construction. Dual motor coupled to gear box, glazed cabin and roof lights. "FROG" patent quick detachable fittings and high-speed mechanical winder. The model aeroplane "par excellence."

PRICE
17/6
Complete with high-speed winder box, spare motor, inserter rod, gear box oil, elastic lubricant and illustrated flying manual.

Designed and manufactured by International Model Aircraft Ltd.

Own a 'FROG' or a 'PUSS MOTH' and join the FROG FLYING CLUB. Membership free, write for particulars.

"TERN" MONOPLANE

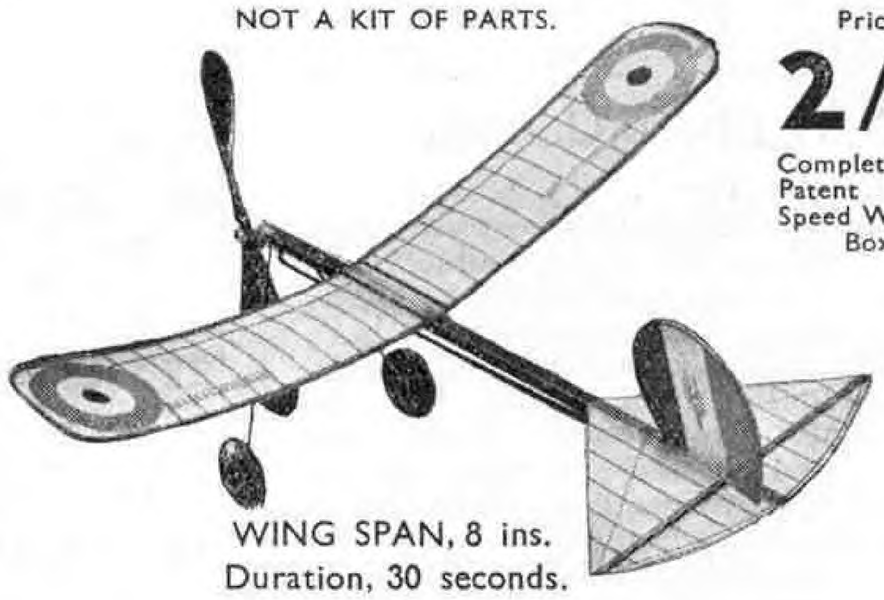


A splendid model for outdoor flying. Very durable construction. Wing Span 15 ins. Flies 200 ft. **1/6**

"TADPOLE" MONOPLANE FOR INDOOR FLYING

This is the amazing new model for indoor flying. It will rise off the floor or table or even off its own box, and fly round any room—large or small. Marvellous flights—no skill required—**quickly wound with its patented High-Speed Winder Box.**

NOT A KIT OF PARTS.



Price **2/6**
Complete with Patent High-Speed Winder Box.

WING SPAN, 8 ins.
Duration, 30 seconds.

"FROG" MODEL AIRCRAFT ARE SOLD AT ALL GOOD STORES AND TOYSHOPS

Sole Concessionaires :

LINES BROS. LTD., Tri-ang Works, Morden Rd., London, S.W.19

Boys!

These three cycle tyres have been specially designed and built for you. You cannot do better than fit

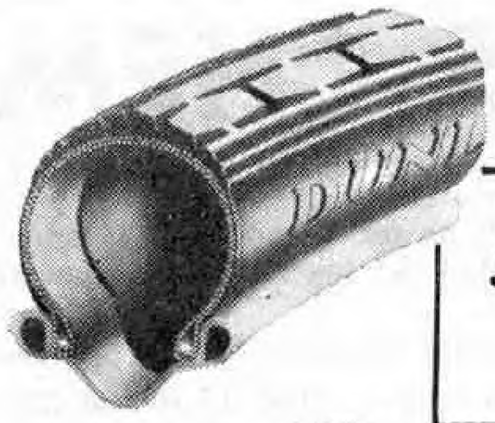
DUNLOP

The Juvenile and the Champion Juvenile are for every-day cycling, for pottering and touring; and the Sports Juvenile is a really speedy tyre for fast road work.

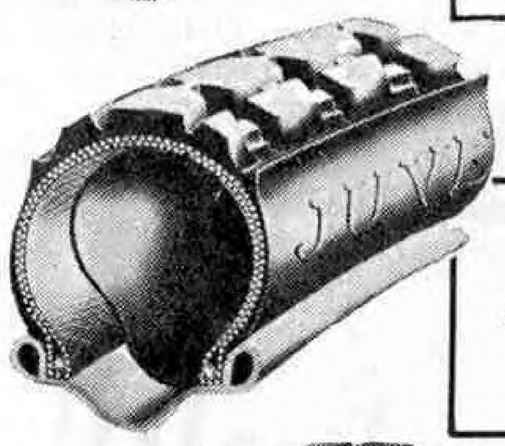
DUNLOP

for

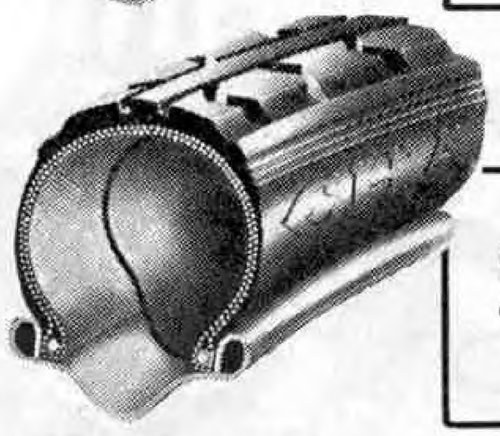
TYRES, SADDLES, TOOLBAGS, INFLATORS, REPAIR OUTFITS.



DUNLOP JUVENILE
COVER 5/6
TUBE 2/6



DUNLOP SPORTS JUVENILE
COVER 4/6
TUBE 2/3



DUNLOP CHAMPION JUVENILE
COVER 3/6
TUBE 1/9

DUNLOP RUBBER CO. LIMITED, FORT DUNLOP, BIRMINGHAM. *Branches throughout the World.*

C.F.H.

4H/316

"It's more than TWICE as STRONG, that's why I always use SECCOTINE"

REGD.



A little goes a long way

Why should you always use Seccotine? Just this: It is the strongest adhesive in the world. Tests have proved this. Actually, Seccotine is more than TWICE AS STRONG as other adhesives. That is proof, not guesswork.
But remember when you use Seccotine to apply it very sparingly. A very little is all that is necessary to get a perfect joint. Made by British workpeople.

Obtainable in tubes 4½d., 6d. *and* 9d. *from all good Stationers, Ironmongers and General Stores.*

There is only ONE SECCOTINE

POST THIS COUPON FOR FREE BOOKLET

To Dept. M,
McCaw, Stevenson & Orr Ltd., Belfast.

I should like to have, post free, a copy of your Free Booklet.

Name.....

Address.....

.....

LOTT'S CHEMISTRY

There are hours of really interesting experimenting ahead of the Boy who possesses a box of Lott's Chemistry. Each Set is complete with chemicals, apparatus, and instructions for a remarkable range of experiments. Write to-day for fully illustrated list together with some fascinating extracts from the experiments.

Spare Supplies of the Chemicals and Apparatus can be obtained.

Complete Sets at 2/–, 3/6, 6/–, 10/6, 15/6 and 21/–.
Larger Students' Cabinets at 31/6, 42/–, 73/6 and 105/–.

Obtainable at all leading Toy Dealers and Stores.

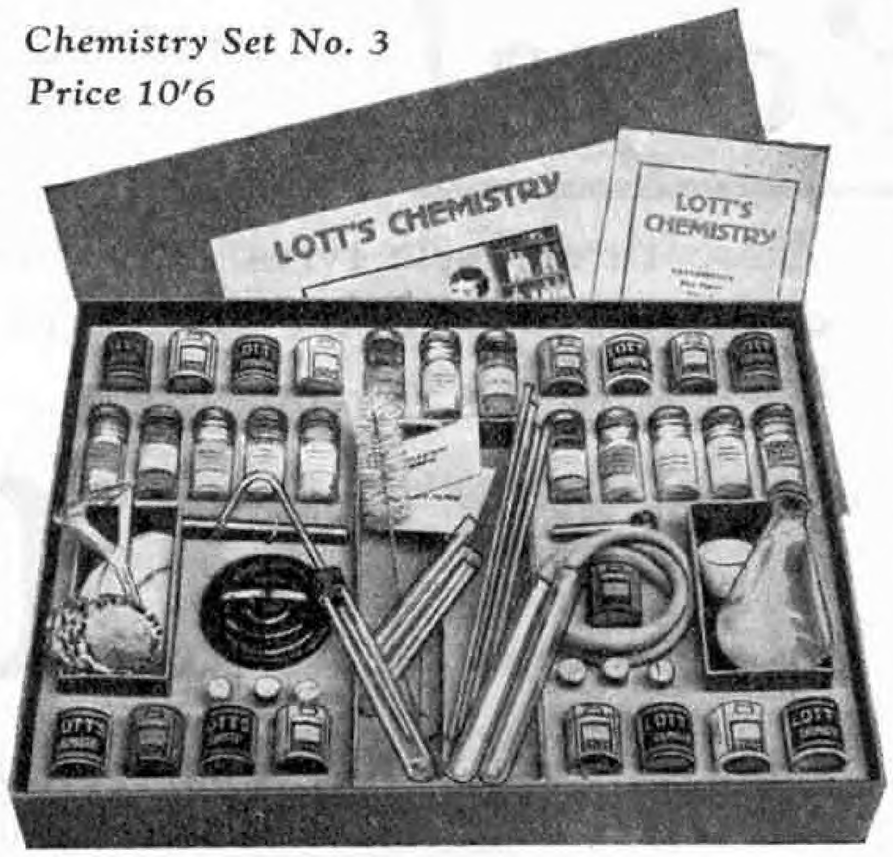


Electricity Set No. 3 Price 21/-

These prices apply only to Great Britain and Northern Ireland. Obtainable in South Africa at Stuttaford & Co. Ltd., Capetown; J. L. Van Schaik Ltd., Pretoria; Canada: at the T. Eaton Co., Toronto; H. Morgan & Co. Ltd., Montreal; India: Daryanamal & Bros., Bombay Sports Depots.

Write for Lists to: Dept. M.M., LOTT'S BRICKS LTD., WATFORD, HERTS.

Chemistry Set No. 3 Price 10/6



LOTT'S ELECTRICITY

These sets provide a low priced equipment for performing a remarkable range of Electricity Experiments.

BOX 1. Makes a compass, magnet, galvanometer, battery, electroscope, and includes also many other Experiments in Magnetism, Static and Current Electricity. **Price 6/-**

BOX 2. In addition to the above makes an electro-magnet, buzzer, water voltameter, potentiometer, electric signal and traffic signal. Contains two complete Leclanche cells of good capacity with necessary chemicals. **Price 12/6**

BOX 3. In addition to the above, makes a gold-leaf electroscope, electrophorus (that can give ½" sparks), electric motor, a sensitive galvanometer (that can detect a current of one milliampere), a Wheatstone Bridge, hot-wire ammeter, electric indicator, with many other fascinating experiments. Contains three Leclanche cells, a powerful horseshoe magnet and a built up buzzer. **Price 21/-**

"Camping and Rambling Holidays"

New and Enlarged Edition for 1934

THIS attractive Great Western Railway publication contains addresses of a large number of selected sites specially chosen for Camping, together with all necessary preliminary particulars relating to site, landowner or tenant, amount of land available, drinking water on site, etc.,

and is obtainable FREE

from G.W.R. London and Provincial Offices, or from the Superintendent of the Line, G.W.R., Paddington Station, London, W.2.

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Hamleys News

Estd 1760

·HAMLEY·BROTHERS·LTD

200-202, REGENT ST., LONDON, W.1

Number Thirteen — ITEMS OF OUTSTANDING INTEREST — May, 1934

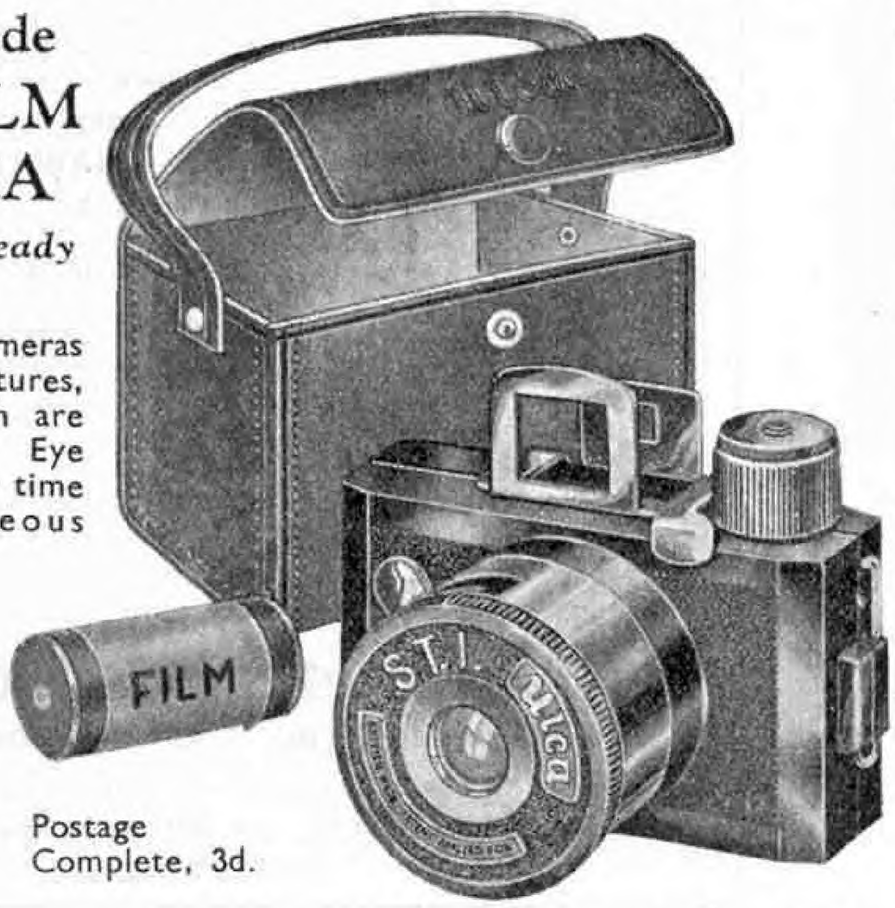
The World's Smallest Camera!

British-Made
ROLL FILM
CAMERA

Thousands already sold!

These amazing cameras take perfect pictures, stamp size, which are easily enlarged. Eye level view finder, time and instantaneous shutter.





Postage Complete, 3d.

The Camera is illustrated actual size

Black Finish - - Price each -	3'11	Leather Case Price each -	1'-
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Hamleys Model Racing and Sailing YACHTS

Hamleys have an immense display of all model boats.

Let Hamleys re-rig and overhaul your present craft. Special sails and spars made to order.

Come and sail these Yachts on the Model Pond—First Floor.

Racing Yachts

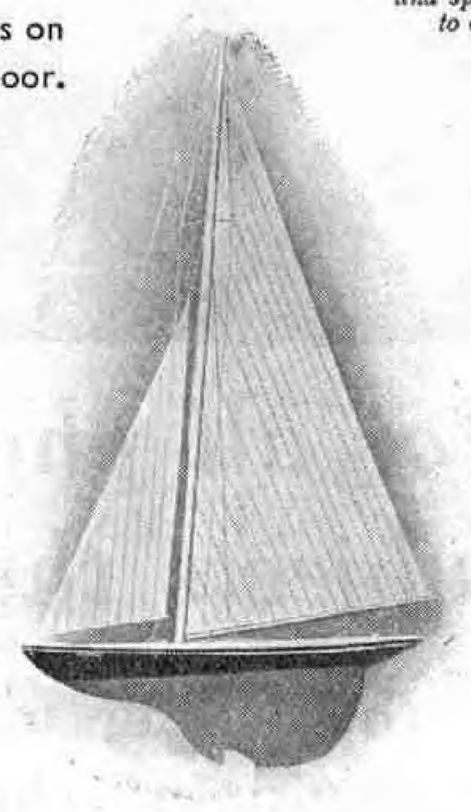
*12 inches	Price	12/6
*15 ,,	,,	19/6
*18 ,,	,,	25/6
21 ,,	,,	32/6
24 ,,	,,	42/-
27 ,,	,,	59/6
30 ,,	,,	79/6
36 ,,	,,	£6/19/6

*Bermuda Rig only.

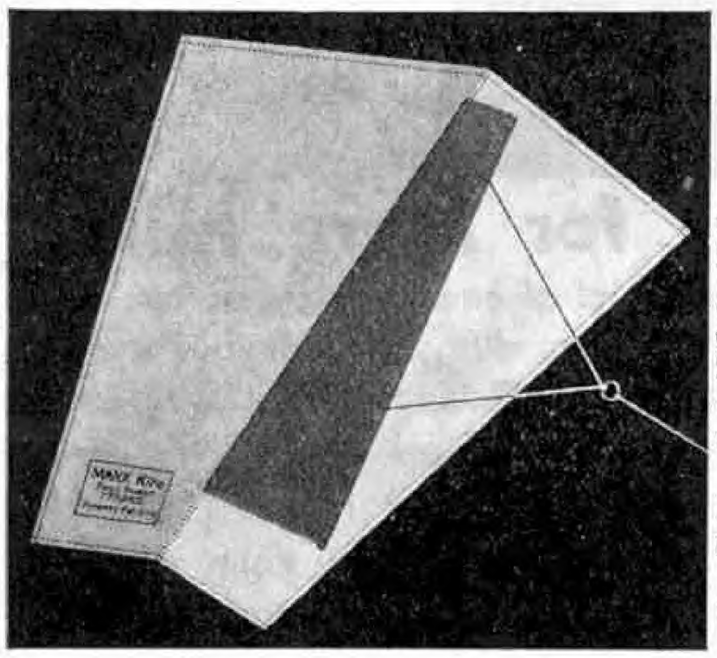
Sailing Yachts

12 inches	Price	4/9
14 ,,	,,	6/6
16 ,,	,,	8/6
18 ,,	,,	11/6
21 ,,	,,	14/6
24 ,,	,,	18/6
27 ,,	,,	25/-
30 ,,	,,	35/-

Bermuda Rig. White Hull with blue water line.



Get your New Kite in time for Whitsun!



The New
WONDER
"MANX"
KITE

fitted with HIGH-SPEED flapping sides. A scientific invention of a continuous High-Speed automatic movement in the air makes them fly like birds.

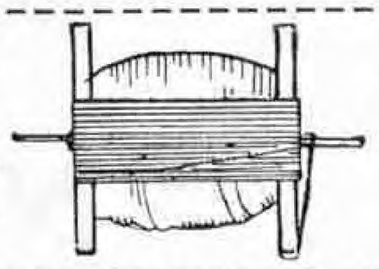
Made of extra strong cloth in very bright colours.

Prices each 2/6, 3/6, 4/6 and 5/6

Postage 3d.

KITE WINDERS
With Cord

This strong cord is specially recommended for these kites. Prices 1/-, 1/9, 2/9 and 4/6.



The 'TADPOLE' MONOPLANE
Specially Designed for
INDOOR FLYING

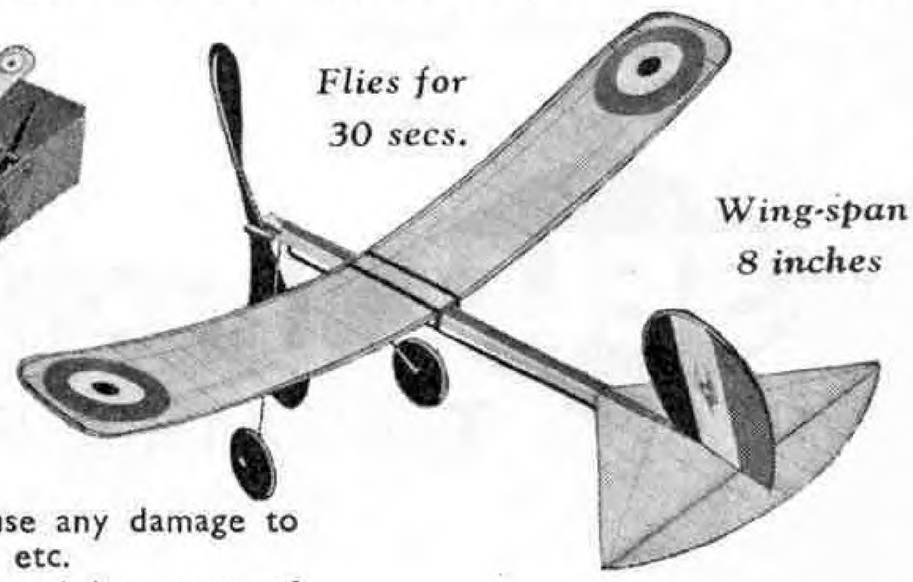
Hold an Aerobatic Display in your own room



High-Speed Winder Box

Flies for 30 secs.

Wing-span 8 inches



- Cannot cause any damage to furnishings, etc.
- Quickly wound by means of patent high-speed winder-box.
- Each model packed in a box with attractive design on lid printed in full colours.
- 320 Tadpoles weigh only 1 lb.

Complete with instructions and High-Speed Winder-Box.

2/6

Postage 6d.

For Toys, Sports and Games — HAMLEYS—200-202, REGENT ST., LONDON, W.1



For all photographic subjects that interest

the young mechanic and engineer, there are no films so certain to give fine pictures as . . . .

SELO **THE FAST ROLL FILM**

—a splendid film for everyday photography in normally bright light

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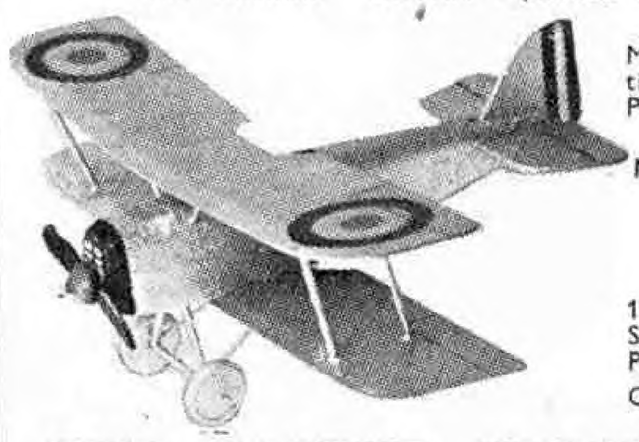
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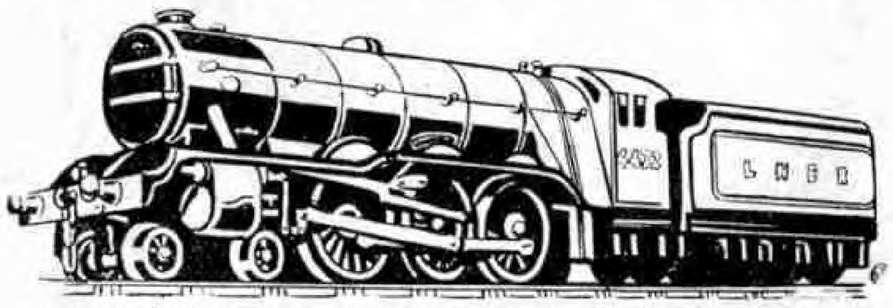
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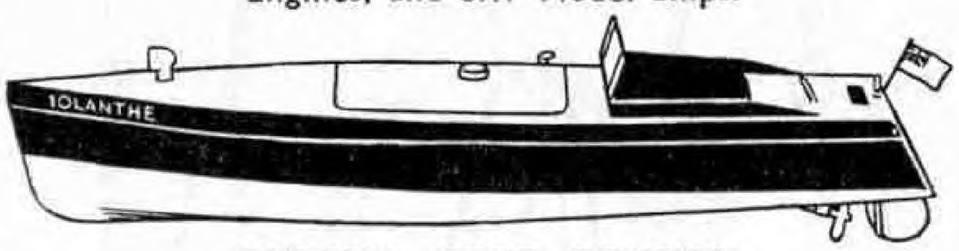
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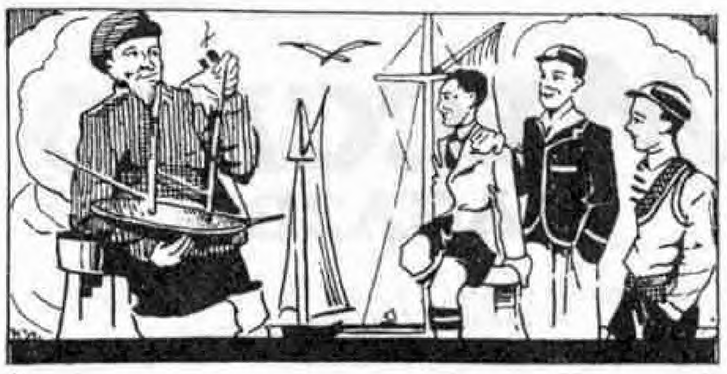
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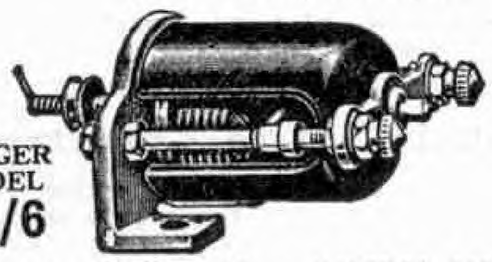
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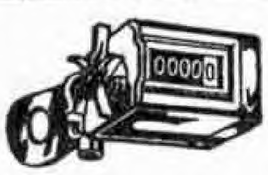
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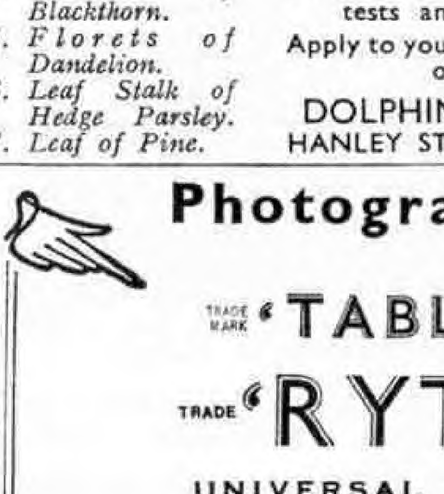


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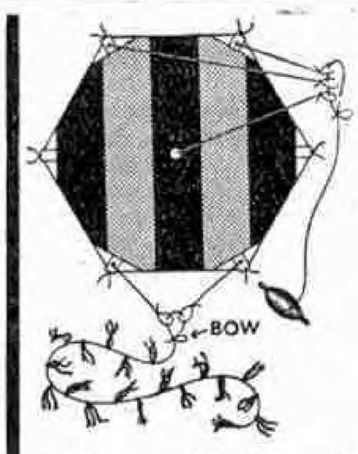
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The Skybird League

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The League's first annual rally, held at Hamley's, Regent Street, London, W.1, has just concluded. It proved an enjoyable event that augurs well for the League's future.

Skybird model-building competitions were a feature of the rally, and some 47 models—representing all types of aircraft—were entered. The principal award, a Challenge Cup presented by "Squadron-Leader," was won by Club 98 (Westcliff-on-Sea). The Runners-up Cup, presented by A. J. Holladay & Co. Ltd., was won by Club 100, and the 3rd, 4th and 5th prizes, presented by Hamley Brothers Ltd., were secured by Clubs 80, 22 and 103 respectively.

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Stamp Advertisements cont. from p. 428

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1,000 DIFFERENT STAMPS
on approval, from which you may select any 100 for 3/–. These Stamps are **EXCELLENT VALUE** and include some catalogued at 1/– each or more.
MORE ADVANCED Collectors are invited to send for better class selection on approval, priced at one-fifth to one-third Catalogue.
H. HARDY,
6, Birchington Road, Hornsey, London, N.8.

Bird Nesting with a Camera
A Correction

We regret that the photograph illustrating the article on "Bird Nesting with a Camera" that appears on page 297 of our April issue was wrongly described as that of a nest of the red grouse. It actually shows a nest of the snipe, which lays four eggs that are more sharply pointed than the 8 to 11 eggs laid in a nest of the red grouse.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICE:—
LIVERPOOL 13, ENGLAND.
Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/– for six issues and 8/– for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/–. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Small Advertisements. 1/6 per line (average seven words to the line), or 16/– per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest net sale figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 1st of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Ordering the "M.M." Overseas

Readers Overseas and in foreign countries may order the "*Meccano Magazine*" from regular Meccano dealers or direct from this office. The price and subscription rates are as above, except in the cases of Australia, where the price is 1/2 per copy (postage extra), and the subscription rates 8/– for six months and 16/– for 12 months (post free); Canada, where the price is 10c. per copy, and the subscription rates 65c. for six months, and $1.25 for 12 months (post paid).

The U.S.A. price is 15c. per copy, and the subscription rates $1 and $2 for 6 and 12 months respectively (post free).

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the United Kingdom and Northern Ireland. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 34, St. Patrick St., Toronto.
UNITED STATES: Meccano Co. of America Inc., New Haven, Conn. Meccano Co. of America Inc., 200, Fifth Av., New York.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Models Limited, Third Floor, Paykel's Buildings, 9, Anzac Avenue (P.O. Box 129), Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.
INDIA: Karachi: Daryanamal and Bros., Elphinstone Street, Bombay; Bombay Sports Depot, Dhobi Talao. Calcutta: Bombay Sports Depot, 13/C, Old Court House Street.

The Editor wishes to make known the fact that it is not necessary for any reader to pay more than the published price. Anyone who is being overcharged should lodge a complaint with the Meccano agent in his country or write direct to the Editor.

The WEBLEY SERVICE AIR RIFLE, Mk. II.
No Licence required to purchase
WRITE FOR DESCRIPTIVE FOLDER

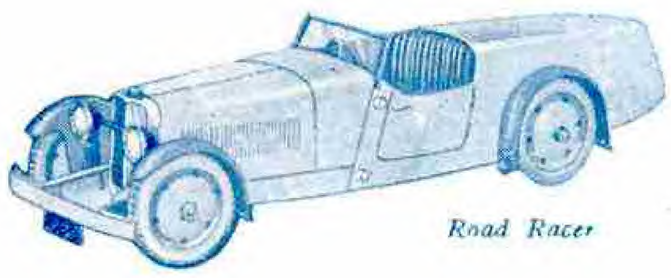


Rooks, Rabbits, Rats, Sparrows and similar vermin can be destroyed by this extremely accurate and powerful Air Rifle
Ideal for Target Practice.
Calibre 22 or 177 With Leafsight and Peepsight.
WEBLEY & SCOTT, Ld. 87, Weaman St., BIRMINGHAM 4

MECCANO



Sports Tourer (with hood)



Road Racer



Sports Tourer

No. 1 Meccano Motor Car Constructor Outfit

The motor car models that can be built with this Outfit are the finest you ever saw. Look at the examples illustrated above and think of the fun you could have building these and other types equally realistic.

No. 1 Outfit is available in four different colour combinations and is supplied complete with powerful Clockwork Motor. Price **14/6**

MOTOR CAR CONSTRUCTOR OUTFITS

Meccauto 538189

One of the most fascinating of all boys' hobbies, either indoor or outdoor, is model car operation with cars built from Meccano Motor Car Constructor Outfits. Perfect miniature reproductions of many different types of car can be built with these splendid Outfits, including sports four-seaters, speed cars, sports coupés and others.

Now is the time to get a Meccano Motor Car Outfit. You will never grow tired of building and running the superb models that you will be able to build.



Choice Range of Colours

If extra parts in any of the standard colours are required they can be purchased from any Meccano dealer. In addition to the four standard colour combinations the following parts are available in the colours indicated :

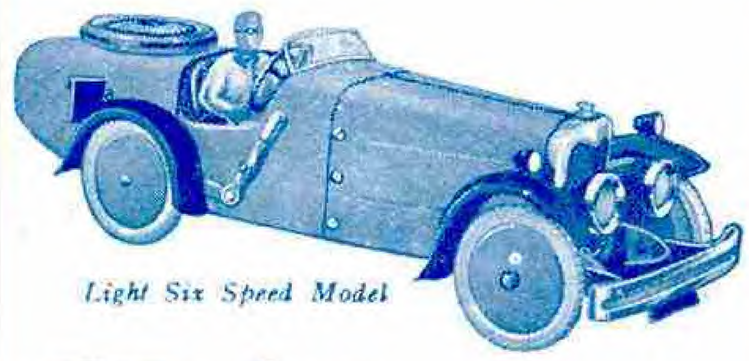
Body Sections : orange, yellow Wheels : orange, yellow. Wings: orange, green.

Motor Car Garage

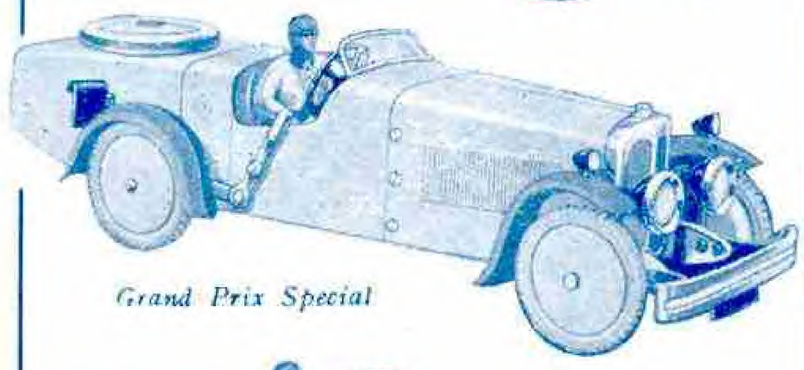
The Meccano Motor Car Garage provides accommodation for any Meccano model motor car or other cars of suitable size. Inside dimensions : Height 5 in., Length 13 in., Width 7½ in. Price **7/-**

Motor Car Lighting Set

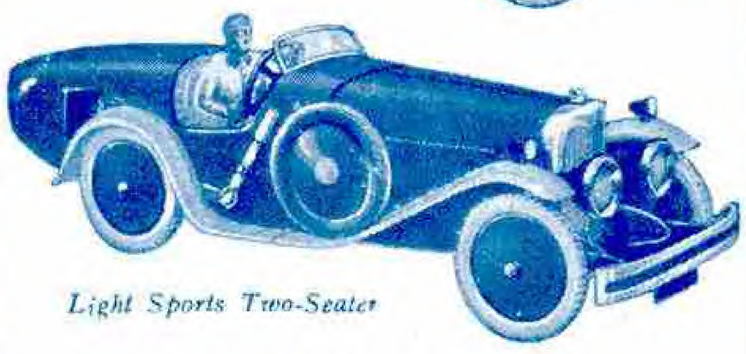
This Lighting Set enables the headlamps of Motor Car models built with the No. 2 Motor Car Outfit to be electrically lighted. Price **2/6**



Light Six Speed Model



Grand Prix Special



Light Sports Two-Seater

No. 2 Meccano Motor Car Constructor Outfit

Larger models of a superior type can be built with No. 2 Outfit. Their handsome and realistic appearance may be judged from the above illustrations.

No. 2 Outfit is available in four different colour combinations, and a powerful Clockwork Motor that gives a run of 150 feet on one winding is included. Price **25/-**



No. 1 Meccano Motor Car Outfit



No. 2 Meccano Motor Car Outfit

MECCANO LTD.

BINNS ROAD

LIVERPOOL 13

HORNBY SPEED BOATS

New Models
Brighter Colours
Remarkable Efficiency

The 1934 Hornby Speed Boats, Racing Boats and the new Water Toy are the finest examples of model craftsmanship ever produced. Exceptional performance, graceful lines and beautiful finish are the outstanding characteristics of these splendid boats. They introduce a new standard of excellence in British toys. Every boy will be proud to possess one of them.

A selection of Hornby Speed Boats and Hornby Racing Boats is illustrated in half tone on pages 396 and 397 of this issue. The complete series is illustrated in full colour.

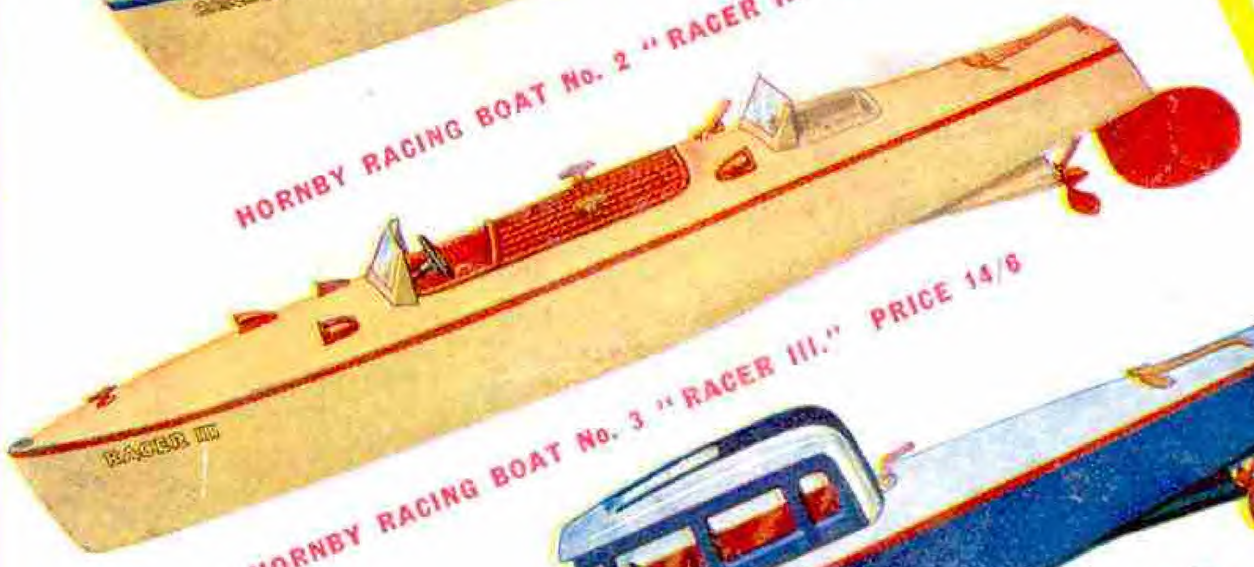
Ask your dealer to show you the full range and see for yourself how wonderful these boats really are.



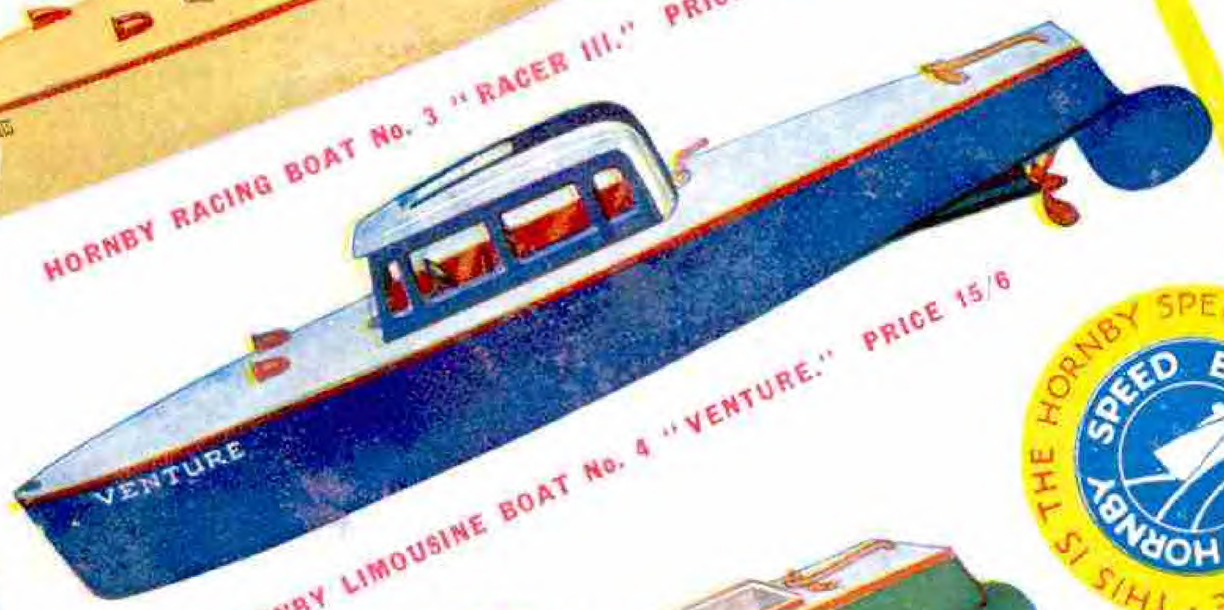
HORNBY SPEED BOAT No. 1 "HAWK." PRICE 2/11



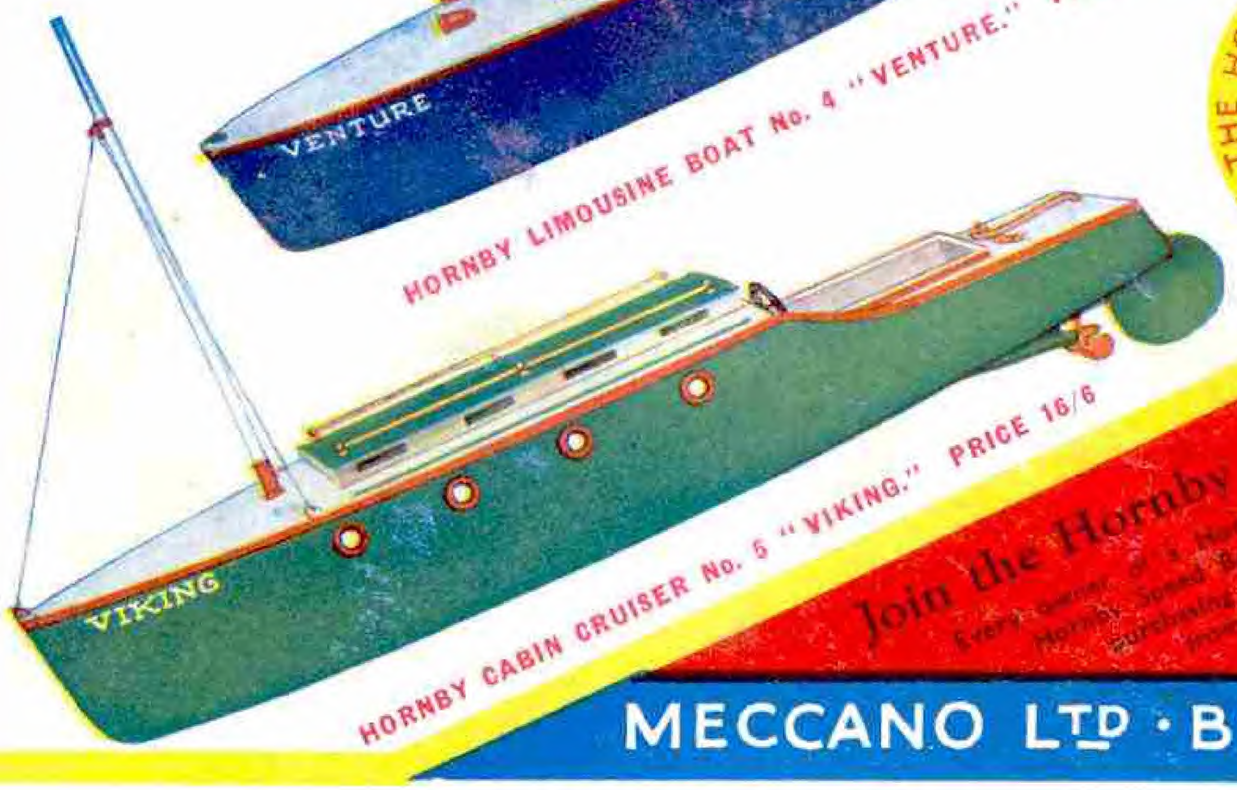
HORNBY RACING BOAT No. 2 "RACER II." PRICE 8/6



HORNBY RACING BOAT No. 3 "RACER III." PRICE 14/6



HORNBY LIMOUSINE BOAT No. 4 "VENTURE." PRICE 15/6



HORNBY CABIN CRUISER No. 5 "VIKING." PRICE 16/6

Price List

HORNBY SPEED BOATS

HORNBY SPEED BOAT No. 1 "HAWK." Price **2/11**. Travels over 100 ft. on one winding. Dimensions: Length 9½ in. Beam 3 in.

HORNBY SPEED BOAT No. 2 "SWIFT." Price **7/6**. Travels over 300 ft. on one winding. Dimensions: Length 12½ in. Beam 3 in.

HORNBY SPEED BOAT No. 3 "CONDOR." Price **12/6**. Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY LIMOUSINE BOAT No. 4 "VENTURE." Price **15/6**. Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY CABIN CRUISER No. 5 "VIKING." Price **16/6**. Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY RACING BOATS

HORNBY RACING BOAT No. 1 "RACER I." Price **4/6**. Travels over 120 ft. at high speed on one winding. Finished in Cream and Green. Dimensions: Length 8½ in. Beam 2⅜ in.

HORNBY RACING BOAT No. 2 "RACER II." Price **8/6**. Travels over 200 ft. at high speed on one winding. Finished in Blue and Cream. Dimensions: Length 12½ in. Beam 3 in.

HORNBY RACING BOAT No. 3 "RACER III." Price **14/6**. Travels over 300 ft. at high speed on one winding. Finished in Red and Cream. Dimensions: Length 16½ in. Beam 3½ in.

HORNBY WATER TOY

HORNBY WATER TOY (DUCK). Price **3/3**. Travels over 100 ft. on one winding. Finished in appropriate colours. Dimensions: Length 9½ in. Beam 3 in.

Ask your dealer to show you the 1934 Hornby Speed Boats and Racing Boats

THE HORNBY SPEED BOAT CLUB BADGE · THIS IS

HORNBY SPEED BOAT CLUB

Join the Hornby Speed Boat Club

Every owner of a Hornby Speed Boat should join the Hornby Speed Boat Club. This may be done by purchasing a special blank illustrated above from any Meccano dealer or direct from Meccano Ltd., Binns Road, Liverpool 13. Price, United Kingdom 6d., New Zealand 10d., South Africa 9d., Canada 20 cents.

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